DEPARTMENT OF THE ARMY TECHNICAL MANUAL	TM 95-225
DEPARTMENT OF THE NAVY MANUAL	NAVAIR 16-1-520
DEPARTMENT OF THE AIR FORCE MANUAL	AFMAN 11-225
FEDERAL AVIATION ADMINISTRATION ORDER	8200.1B

UNITED STATES STANDARD FLIGHT INSPECTION MANUAL

January 2003

DEPARTMENTS OF THE ARMY, THE NAVY, AND THE AIR FORCE
AND
THE FEDERAL AVIATION ADMINISTRATION

DISTRIBUTION: ZVN-820 **Initiated By: AVN-230**

The material contained herein was formerly issued as the United States Standard Flight Inspection Manual, dated December 1956.

The second edition incorporated the technical material contained in the United States Standard Flight Inspection Manual and revisions thereto and was issued as the United States Standard Facilities Flight Check Manual, dated December 1960.

The third edition superseded the second edition of the United States Standard Facilities Flight Check Manual; Department of Army technical manual TM-11-2557-25; Department of Navy Manual NAVWEP 16-1-520; Department of the Air Force Manual AFM 55-8; United States Coast Guard Manual CG-317.

The current FAA Order 8200.1B is a revision of FAA Order 8200.1A. FAA Order 8200.1A was a revision of the third edition of the United States Standard Flight Inspection Manual, FAA OA P 8200.1; Department of the Army Technical Manual TM 95-225; Department of the Navy Manual NAVAIR 16-1-520; Department of the Air Force Manual AFMAN 11-225; United States Coast Guard Manual CG-317; and is effective upon receipt.

RECORD OF CHANGES

DIRECTIVE NO. **8200.1B**

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL

FAA Form 1320-5 (6-80) USE PREVIOUS EDITION U.S. GOVERNMENT PRINTING OFFICE: 771-860/441

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FOREWORD

The purpose of this manual is to prescribe standardized procedures for the flight inspection of air navigation services. It is not intended as authorization for an agency to assume flight inspection authority over any group of services which are not now under its jurisdiction. Similarly, it carries no designation of responsibility within any agency unless such has been so designated in its usual procedural manner, such as general orders, regulations, etc.

This manual is directive upon all personnel charged with the responsibility for execution of the flight inspection mission, when such personnel or organization is so designated by its agency. Compliance with this manual, however, is not a substitute for common sense and sound judgment. Nothing in this manual shall be construed to relieve flight inspection crews or supervisory personnel of the responsibility of exercising initiative in the execution of the mission, or from taking such emergency action as the situation warrants.

The Federal Aviation Administration will coordinate and provide approved changes to this manual by means of a page revision method. Revised pages will be transmitted by a Federal Aviation Administration Notice. Recommendations concerning changes or additions to the subject material are welcomed and should be forwarded to one of the following addresses;

Chief of Staff, United States Army, Washington, D.C.
Chief of Naval Operations, Navy Department, Washington, D.C.
Chief of Staff, United States Air Force, Washington, D.C.
Commandant, U.S. Coast Guard, 2100 2nd Street, S.W., Washington, D.C. 20593
Administrator, Federal Aviation Administration, Washington, D.C.

This Manual of Flight Inspection Procedures has been officially approved by: Chief of Staff, U.S. Army; Chief of Naval Operations, U.S. Navy; Chief of Staff, U.S. Air Force; Commandant, U.S. Coast Guard; and Administrator of the Federal Aviation Administration.

/s/

Thomas C. Accardi
Program Director of Aviation
System Standards

SECTION 101. INTRODUCTION

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SECTION 101. INTRODUCTION

101.1 PURPOSE. This order contains the policy, procedures, and criteria for flight inspection and certification of air navigation services, including the instrument flight procedures they support. The order applies to the flight inspection of all National Airspace System (NAS) and Department of Defense air navigation services and instrument flight procedures.

101.2 DISTRIBUTION. This order is distributed to selected offices on special mailing list ZVN-820. It is available on the Internet (**http://www.avn.faa.gov**). Distribution within the Department of Defense is handled by the National Imagery & Mapping Agency. For the U.S. Air Force, this revision is included in the AF STDPUBs CD-ROM and is available on the Internet (**http://afpubs.hq.af.mil/**).

101.3 CANCELLATIONS.

a. The following directives are canceled:

(1) FAA Order 8200.1A, dated May 22, 1996.

(2) FAA Order 8200.1A, Change 1, dated September 2, 1997.

(3) FAA Order 8200.1A, Change 2, dated August 19, 1998.

(4) FAA Order 8200.1A, Change 3, dated July 3, 2000.

(5) FAA Order 8200.1A, Change 4, dated June 1, 2001.

b. The following Numbered Memorandums are canceled.

(1) AVN-200-99-006, dated January 8, 1999

(2) AVN-200-00-307, dated June 20, 2000.

(3) AVN-200-01-300, dated October 31, 2000.

(4) AVN-200-01-304, dated March 15, 2001.

(5) AVN-200-01-307, dated June 2, 2001.

(6) AVN-200-01-308, dated June 6, 2001.

(7) AVN-200-01-310, dated August 1, 2001.

(8) AVN-200-01-311, dated August 9, 2001.

101.4 EXPLANATION OF CHANGES. This order has been rewritten to eliminate unnecessary information, clarify guidance and procedures, and include new and revised criteria to make them more compatible with new flight inspection equipment and navigational aids. Substantive changes to Sections are as follows:

a. Section 104.

(1) Paragraph 104.31. Guidance added for commissioning of facilities on incomplete runways.

(2) Paragraph 104.52. Second sentence added for clarification of antenna changes to different types being classified as a reconfiguration inspection.

b. Section 105.

(1) Paragraph 105.3. Associated equipment clarified.

(2) Paragraph 105.4 RHO-THETA Receiver Checkpoints paragraph added. Allows a facility to continue in service if the checkpoints cannot be flight checked.

(3) Paragraph 105.5 (formerly 105.4). Requirements for newly commissioned and reconfigured precision systems clarified.

(4) Guidance added for periodicity for localizer clearances at LCA.

c. Section 106. Reporting requirements for flight information clarified in Paragraph 106.65.

d. Section 107. Rules for restricted facility use and NOTAM examples clarified.

e. Section 109. Paragraph 109.74, Modulation Tolerances, made more explicit to correct long-standing omission.

f. Section 201.

(1) Paragraph 201.31, Checklist. Changes made to footnotes (2), (6), and (7). Footnote 10 added for RANTEC TACAN systems. Periodic requirements of Numbered Memorandum AVN-200-01-311 added.

(2) Paragraph 201.3203a. En Route radials altitude requirements clarified.

(3) Paragraph 201.32032 deleted. Figure 3 also deleted and numbers of remaining figures adjusted.

(4) Paragraph 201.3204. Title of paragraph changed and terminal radial requirements of Numbered Memorandums AVN-200-01-308 and AVN-200-01-311 included. Eliminates requirement for TACAN null checks when facility is used as the FAF.

(5) Paragraph 201.32043. Paragraph (Terminal Fixes) deleted and incorporated in Paragraph 3204c per Numbered Memorandum AVN-200-01-308.

(6) Paragraph 201.32051. Alignment orbit reporting requirements clarified.

(7) Paragraph 201.32052. Coverage reporting requirements clarified. Incorporates Numbered Memorandum AVN-200-01-308. Guidance for procedural use below FISSV added.

(8) Paragraph 201.3211, Crossing Radials on ILS Approaches, added.

(9) Paragraph 201.4602. Modulation limits reporting requirements clarified. Incorporates Numbered Memorandum AVN-200-01-304.

g. Section 212. Direction Finding bearing accuracy checks clarified. Incorporates Numbered Memorancum AVN-200-01-304.

h. Section 215. Paragraph 215.31, Checklist. ATCRBS Power Optimum corrected.

i. Section 216.

(1) Paragraph 216.24. TERPS specialist changed to procedures specialist.

(2) Paragraph 216.31. Checklists separated by equipment type.

(3) Paragraph 216.32. AFIS method and Azimuth Only Procedures information added.

(4) Paragraph 216.3203. Multiple angle requirements clarified.

(5) Paragraph 216.32041. Lateral coverage of the PAR clarified.

(6) Paragraph 216.3205. Moving Target Detector (MTD) information added.

(7) Paragraph 216.3206. Glidepath alignment reporting requirements clarified. Added AFIS as a measurement method.

(8) Paragraph 216.3207. Added VGSI to PAR coincidence.

(9) Paragraph 216.3209. Title changed to Lighting Systems

(10) Paragraph 216.3210. Communications requirements clarified.

(11) Paragraph 216.3212. Standby power requirements clarified.

(12) Paragraph 216.5. Tolerances reformatted.

j. Section 217.

(1) Paragraph 217.23. Special Equipment Requirements clarified. Limitations imposed on commissioning of ILS(s).

(2) Figure 217-1B(1). 4 nm arrow redefined as distance from Point A to Threshold to match text.

(3) Paragraph 217.3101a. Notes 6 and 7 added to Single Frequency Localizer, LDA(s), and SDF(s) Checklist. Localizer Only Minima requirements added.

(4) Paragraph 217.3101b. Notes 4 and 5 added to Dual Frequency Localizer Checklist. Localizer Only Minima requirements added.

(5) Paragraph 217.3101d. Note 5 added to Sideband Reference Glide Slope Checklist to clarify PM requirement.

(6) Paragraph 217.3101g. Notes 6 and 7 added to Endfire Glide Slope Standard Checklist. Additional transverse structure requirements added. Numbered Memorandum AVN-200-01-309 incorporated.

(7) Paragraph 217.3202a. Sentences added for clarification of Modulation Level Inspections of dual frequency antennas. Off-centerline clearance modulation checks allowed. Numbered Memorandum AVN-200-01-310 incorporated.

(8) Paragraph 217.3206. Course Sector Width and Symmetry inspection requirements clarified. Numbered Memorandum AVN-200-01-310 incorporated.

(9) Paragraph 217.308. Clarified criteria for alignment monitors after the airborne alignment is changed.

(10) Paragraph 217.3209. RF Power Monitor Reference for ESV inspection requirements clarified.

(11) Paragraph 217.3210. Front Course and Back Course Clearance and Clearance Comparability clarified.

(12) Paragraph 217.3212. Redefined intersection requirements within the SSV.

(13) Paragraph 217.3304. Footnote (8) added to Airborne Phase Verification Procedures checklist.

(14) Paragraph 217.33053. Uses more descriptive terminology.

(15) Paragraph 217.3306. Mean width requirements added. The benefits of checking structure-below-path angles during monitor diphase checks added.

(16) Paragraph 217.3307. Clearance Below the Path requirements clarified. Incorporates Numbered Memorandum AVN-01-200-311. Removes reference to endfire being only CAT I system.

(17) Paragraph 217.3309. Clarifies tilt check groundtrack requirements.

(18) Paragraph 217.3310. Information added for factors affecting angle alignment.

(19) Paragraph 217.3311. Transverse Structure for Endfire Glide Slope inspection requirements clarified. Numbered Memorandum AVN-200-01-309 incorporated. Added maximum transverse structure values for various glide angles.

(20) Figure 217-3, Transverse Strucutre Analysis Endfire Glide Slope, added.

(21) Paragraph 217.35. Third sentence added for verifying RHO-THETA crossing radials associated with an ILS approach.

(22) Paragraph 217.44. Reference point for restrictions clarified.

(23) Paragraph 217.45. Added values for maintenance alert requirements.

(24) Paragraph 217.47. CAT III adjust and maintain requirements added.

(25) Paragraph 217.48. Threshold Crossing Height (TCH) / Reference Datum Height (RDH) requirements added. Reference to guidance in existing orders added.

(26) Paragraph 217.5. Changes made to checklist requirements.

k. Section 220.

(1) Paragraph 220.31. Changes made to checklist. Clarified requirement for coverage on DEU change for mobile MLS.

(2) Paragraphs 220.3201a(2)(b) and 220.3201b(3)9b). Information added regarding MLS receiver unlocks.

(3) Paragraph 220.3203c. Reporting of MLS approaches which support azimuth only minima clarified.

(4) Paragraphs 220.3301 and 220.3302. Clarified lateral coverage requirements.

l. Section 301. Definitions for Expanded Service Volume (ESV), Flight Inspection Standard Service Volume (FISSV), ILS Localizer Back Course Zone 3, and ILS Point "C" clarified. ASIS acronym added.

101.5 BACKGROUND

a. U.S. Policy. International Group on International Aviation (IGIA) 777/4.6G specifies that the FAA will provide flight inspection of the common air navigation system, U.S. military aids worldwide, reimbursable services to other countries, and encourage other countries to establish their own flight inspection capability.

b. Program Objectives. The following objectives reflect FAA philosophy. Current and future planning should be aligned to these objectives.

(1) Adequate site survey and analysis of ground and inflight data.

(2) Correlated ground and flight measurements at the time of facility commissionings.

(3) System reliability to meet justified user needs.

(4) Maximum reliance on ground measurements supported by inflight measurements of those facility parameters which cannot satisfactorily be measured by other means.

(5) Through continued inflight surveillance of the National Airspace System (NAS), determine system adequacy, isolate discrepancies, and provide feedback for system improvement.

c. The Interface with Agency Rules. Instrument flight procedures and ATC services require periodic flight surveillance of the air navigation system and dictate strict enforcement of the performance standards adopted for each aid.

d. Flight inspection programs were unified under the FAA by Executive Order 11047, August 28, 1962, subject to the provisions of Executive Order 11161, July 7, 1964. The programs are based on joint DOD/FAA standards, procedures, techniques, and criteria.

e. The design standards for air navigation services are documented in Annex 10 to the Convention on International Civil Aviation Organization (ICAO) and in various FAA standards and directives.

f. Quality Assurance. Flight inspection is the quality assurance program which verifies that the performance of air navigation services and associated instrument flight procedures conform to prescribed standards throughout their published service volume.

101.6 DEFINITIONS. This manual contains policy statements and guidance material. Directive verbs are used.

a. Use SHALL when an action is mandatory.

b. Use WILL when it is understood the action will be taken.

c. Use SHOULD when an action is desirable but not mandatory.

d. Use MAY when an action is permissible.

101.7 UNIT OF MEASUREMENT. Unless otherwise stated, the following references are used throughout this manual:

Term(s)	Referenced to
Mile	Nautical Miles
Airspeeds and Ground Speeds	Knots
Bearings, Headings, Azimuths, Radials Direction Information and Instructions	Magnetic North
Altitudes	Absolute (True Height Above the Site or Terrain)

101.8 IDENTIFYING CHANGES IN THE TEXT OF THIS MANUAL. A vertical bar is used to highlight substantive changes in the text. The bar will be inserted in the left margin of each column to identify the changes. This paragraph is used as a typical example.

101.9 AUTHORITY TO CHANGE THIS MANUAL. The Administrator, in coordination with the DOD, reserves the authority to approve changes which establish policy, delegate authority, or assign responsibility. The Program Director of Aviation System Standards may issue changes as necessary to implement policy and standardize procedures and techniques for the flight inspection of air navigation services to ensure accomplishment of the U.S. Flight Inspection Program.

SECTION 102. FLIGHT INSPECTOR'S AUTHORITY AND RESPONSIBILITIES

102.1 AUTHORITY. The flight inspector is authorized to:

a. Perform flight inspections of air navigation services (NAVAIDs) to determine that such services meet applicable tolerances contained in this manual, and that the facility will support the associated instrument flight procedures.

b. Perform surveillance of aeronautical services.

c. Issue NOTAMs subject to the limitations contained in Section 107**.**

d. Certify the signal-in-space of a facility based on the result of the flight inspection.

e. Report hazards encountered during a flight inspection of any type.

f. Take appropriate procedural actions.

102.2 RESPONSIBILITY. The flight inspector is responsible for:

a. Conducting flight inspections in accordance with the procedures established by this manual.

b. Determining the adequacy of the service to meet its required functions.

c. Analyzing and evaluating the flight inspection data to enable a status classification to be assigned.

d. Certifying the signal-in-space of a NAVAID in accordance with the tolerances prescribed in this manual.

e. Coordinating with engineering, maintenance, and/or Air Traffic Operations personnel.

f. Reporting the flight inspection results and status of the facility to the appropriate authority.

g. Providing the technical details for NOTAMs based on the flight inspection data.

h. Making recommendations to military installation commanders regarding NOTAMs for military services.

i. Verifying the accuracy of NOTAMs and published information.

j. Flight inspecting instrument flight procedures prior to their publication.

k. Optimizing facility performance during flight inspections requiring adjustments.

SECTION 103. SPECIAL REQUIREMENTS

103.1 INTRODUCTION. This section describes the concept for the special requirements of the aircraft, flight inspection crewmembers, and airborne and ground support equipment used for flight Inspection.

103.2 AIRCRAFT. Flight inspection organizations (Office of Aviation System Standards (AVN), regions, and the U.S. Military) shall identify specific requirements based on their operational needs. Appropriately equipped aircraft and helicopters, from service proponent or other sources, may be used when required to complete flight inspection requirements. The general characteristics of a flight inspection aircraft should be as follows:

a. Aircraft equipped for night and instrument flight.

b. Sufficient capacity for a flight inspection crew, observers, ground maintenance and/or installation personnel, and required electronic equipment with spares.

c. Sufficient range and endurance for a normal mission without reservicing.

d. Aerodynamically stable throughout the speed range.

e. Low noise and vibration level.

f. Adequate and stable electrical system capable of operating required electronic and recording equipment and other aircraft equipment.

g. Wide speed and altitude range to allow the conduct of flight inspections under normal conditions as encountered by the users.

h. Appropriate for modifications for flight inspection of new and improved navigation services.

103.3 FLIGHT INSPECTION CREW-MEMBERS. Flight inspection organizations certifying air navigation services shall develop a program to formally certify flight inspection personnel. The objectives of this program are to:

a. Grant authority to the flight inspection crewmember who carries out the administration's responsibility of ensuring the satisfactory operation of air navigation services and/or instrument flight procedures.

b. Provide a uniform method for examining employee competence.

c. Issue credentials which authenticate certification authority for the crewmember.

103.4 AIRBORNE AND GROUND SUPPORT EQUIPMENT. Aircraft and ground support flight inspection equipment shall be calibrated to a standard traceable to the National Institute of Standard and Technology (See TI 4160.1).

a. An Automated Flight Inspection System (AFIS), when applicable, is the preferred method for conducting flight inspections.

b. Other AVN Approved Systems (Portable/Utility Class) and Methods (Theodolite, RTT, or Manual) may be used unless prohibited by other guidance for flight inspection. Portable/Utility class equipment, installed in aircraft for the purpose of conducting flight inspections, must be installed in accordance with AVN approved procedures.

SECTION 104. TYPES AND PRIORITIES OF FLIGHT INSPECTIONS

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SECTION 104. TYPES AND PRIORITIES OF FLIGHT INSPECTIONS

104.1 INTRODUCTION. Official flight inspections are of five basic types: site evaluation, commissioning, periodic, special, and surveillance.

104.2 SITE EVALUATION: A flight inspection to determine the suitability of a proposed site for the permanent installation of a facility. It may include checks normally made during a commissioning inspection and any additional tests which may be required.

104.3 COMMISSIONING: A comprehensive flight inspection designed to obtain complete information as to system performance and to establish that the system will support its operational requirements.

104.31 Commissioning of Facilities or Services on Incomplete Runways. Occasionally, a commissioning inspection is performed prior to the completion of runway construction activities, including but not limited to, painting and lighting. When this occurs, a Special Flight Inspection should be performed after completion of the runway work and before the facility is placed into service. The flight inspector performing the commissioning check shall request the Special inspection, specifying the items needing inspection. If, in the flight inspector's judgment, the remaining runway work is negligible and no Special inspection is required before facility use, the condition shall be documented on the Daily Flight Log.

104.4 PERIODIC: A regularly scheduled flight inspection to determine that the system meets standards and supports the operational requirements.

104.5 SPECIAL FLIGHT INSPECTIONS are inspections performed outside the normal periodic interval. They may be used to define/evaluate performance characteristics of systems, subsystems, or individual facilities. Facilities maintenance personnel shall be responsible for coordinating with flight inspection which checks are to be accomplished, based on their requirements and type of maintenance performed on the equipment.

a. USAF ATCALS evaluation requirements. ATCALS evaluation inspections require a minimum of a periodic with monitors type profile for ILS and periodic-type profile for all other facilities.

b. USAF Deployable (Mobile) ATCALS (DATCALS). Flight inspections of DATCALS deployed to support an exercise or operational readiness inspection (ORI), and **not intended for actual use**, are considered special inspections. These facilities will be inspected to the extent necessary to assess the mobile unit's deployment capability. The procedures and checklists contained in Section 109 will normally be accomplished. The ORI/exercise team chief will be responsible, after consulting with the flight inspector, for assessing the facility and determining if the unit could operate during an actual deployment. The facility classification will be "unusable" due to the limited nature of the check.

c. Unapproved Facilities. Inspections of facilities not approved for use (equipment under test, facilities without monitors, etc.) will be special inspections. Since these facilities cannot be commissioned for IFR use, the status will be unusable. Items inspected will be largely dependent on the customer's request.

d. Facility Removal and Replacement. When the equipment replaced is the same type and configuration as the former and located on the same physical site, including antenna location, a special check is required. Required items for an antenna change in each section shall be accomplished as a minimum. Additional requirements of such a check will be jointly determined by the flight inspector and facilities maintenance.

104.51 After Accident. This inspection is performed at the request of the accident coordinator/investigator to verify that system performance is satisfactory and continues to support instrument flight procedure(s).

a. Response. This inspection has a priority of 1a and should be accomplished as soon as possible.

b. Preflight Requirements. The flight inspector shall obtain the following information:

(1) Equipment configuration at the time of the accident, i.e., the receiver(s), transmitter(s), or radar channel(s) in operation.

(2) Instrument flight procedure(s) used.

(3) Any additional information that may aid in the inspection analysis.

c. Inspection Procedure(s).

(1) Coordinate with maintenance to configure the system as indicated in paragraph b(1).

(2) Complete periodic checklist requirements. Only the equipment and instrument flight procedures used by the accident aircraft need to be checked. A VOR or TACAN orbit alignment is not required. Do not make any facility adjustments during the after accident inspection. Any adjustments shall require a separate special inspection.

(3) If a system or procedure has no periodic inspection requirements, evaluate performance in the area in which the accident occurred.

(4) Complete any additional items requested by maintenance, air traffic control personnel, the accident coordinator, or the commander at a military facility.

(5) Where an accident involves contact with the terrain or a manmade obstruction, confirm the procedural controlling obstruction by map study or flight evaluation.

d. Dissemination of After Accident Information. All flight inspection findings or other pertinent accident investigation information shall be restricted to the cognizant accident coordinator/ investigator, maintenance, and air traffic personnel. Results of the flight inspection shall be given to the FAA Inspector-in-Charge (IIC) as soon as possible. A flight inspection report shall be filed in accordance with current directives.

104.52 Reconfiguration: A special flight inspection requested by maintenance when modifications or the relocation of a facility affect the radiation pattern of the facility. Antenna changes to different type antennas shall be classified as a reconfiguration inspection. All commissioning checks should be performed following a facility reconfiguration, except those that are not required as determined jointly by flight inspection and facilities maintenance personnel. Commissioning tolerances shall be applied.

104.53 Inspections of Shipboard TACAN's are considered complete at the termination of the inspection. Any subsequent inspection shall be a new "special" inspection.

104.6 SURVEILLANCE. An ongoing observation of individual components of commissioned systems, procedures, or services. This inspection encompasses spot checks of individual components observed during normal flight operations. No reporting is required unless a discrepancy is found. An out-of-tolerance or unsatisfactory condition found on a surveillance inspection shall require a Daily Flight Log entry, report, and, if necessary, NOTAM action.

104.61 Surveillance of Aeronautical Services. During the course of routine flight operations, flight inspection personnel shall be alert for items which are unusual, substandard, or possibly hazardous.

a. Inspections. Inspections may include, but are not limited to, the following:

(1) Condition of runways, taxiways, and ramp areas.

(2) Runway, taxiway paint markings, and position signs missing or deteriorated to the extent that visual guidance is obscured or missing.

(3) Conditions which may lead to runway incursion by aircraft, vehicles, or pedestrians.

(4) Construction activity at airports which is a hazardous condition or might affect NAVAID performance.

(5) New obstructions in the instrument approach area which might become the controlling obstruction or constitute a hazardous condition.

(6) Brush or tree growth obstructing the view of approach lights.

(7) Obscured or broken runway or obstruction lights.

(8) Other hazardous situations, e.g., bird hazards.

(9) Air traffic services, e.g., clearances, flight plans, communications, etc.

(10) Other services, e.g., weather bureau services or other airport support services.

b. Reports. See FAA Order 8240.36, Instructions for Flight Inspection Reporting, latest edition.

104.7 PRIORITIES OF FLIGHT INSPECTIONS. The priorities listed below shall be used to determine which mission will be supported first when two or more requirements are competing for limited flight inspection resources. With the exception of an After Accident check, all other inspections should be scheduled to make the most effective use of aircraft and aircrew. Schedulers should consider weather, maintenance team availability, other facilities enroute, and impact on both the airport and NAS when scheduling missions.

Priority	**Type of Service**
1a	Accident Investigation, RFI investigation, any facility which has exceeded its inspection interval, inspection of facilities in support of military contingencies, or other nationally directed military deployments.
1b	Restoration of a commissioned facility after an unscheduled outage, restoration of CAT II/III ILS approach minimums, or inspection of NAVAIDs in support of military operational readiness and JCS directed exercises.
1c	Flight inspection of reported malfunctions.
1d	Restoration of a commissioned facility following a scheduled shutdown or inspections supporting DOD NAVAID evaluations (USAF TRACALS).
2a	Site evaluation.
2b	Commissioning inspection of a new facility or new instrument flight procedures.
3a	Periodic inspections.
3b	Restoration of standby equipment (except CAT II/III ILS, see priority lb).
3c	Navigational Aids Signal Evaluator (NASE) evaluations
3d	Restoration of VFR training facilities following a scheduled or unscheduled outage.

SECTION 105. FREQUENCY OF PERIODIC FLIGHT INSPECTIONS

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SECTION 105. FREQUENCY OF PERIODIC FLIGHT INSPECTIONS

105.1 INTRODUCTION. This section prescribes the minimum frequency of periodic flight inspections. More frequent inspections may be made when deemed necessary or as requested by the owner or organization responsible for the operation of the facility.

105.11 General

a. Intervals. Table 105-1 specifies the intervals between scheduled periodic flight inspections. Due dates for periodic inspections are based on this schedule. Military, foreign, and MOA systems, facilities, and procedures may have unique requirements and non-standard inspection intervals. All records and reports will reflect the actual date(s) of the inspection and will specifically denote the date of completion. For inspections completed within the due date window or extension, the next inspection will be predicated upon the scheduled facility due date.

(1) Due date window for facilities with a 90-day periodicity is from 15 days before to 15 days after the due date.

(2) Due date window for all other facilities, systems, and procedures is from 60 days before to 60 days after the due date.

b. Scheduling.

(1) NAVAIDs such as VORTAC, VOR/DME, ILS, MLS, etc., shall be flight inspected as a service with the same due date and inspection interval for all component facilities.

(2) The inspection priority shall be raised to 1a when the system, facility, or procedure has exceeded the end of the due date window.

(3) Periodic inspections are considered complete when all scheduled checks are accomplished except as noted below. When flight inspection of all Standard Instrument Approach Procedures (SIAP(s)) cannot be completed within the periodic window and extension, the periodic inspection may be documented as complete, as directed by the FICO Manager. Special inspections shall be established to ensure the remaining SIAP(s) are completed. In the event the SIAP(s) are not checked by the end of the periodic window/extension, the FICO shall initiate NOTAM action to remove them from service. The SIAP(s) shall be restored by a special flight inspection.

c. Progressive Inspections. The requirements for periodic inspections are specified in a checklist in each section of this order. Partial or progressive inspections may be conducted, provided all of the individual periodic checklist items are satisfied within the due date window.

105.2 Extension of Services Overdue Periodic Inspection. When the inspection of a commissioned NAVAID or SIAP is not completed within the due date window, the window may be extended. The flight inspection priority of a NAVAID or SIAP in an extension is the same as an overdue NAVAID or procedure.

a. The periodic flight inspection window for a ground NAVAID may be extended an additional seven (7) calendar days if the Flight Inspection Central Operations Office (FICO) and regional facility maintenance engineering agree that no conditions exist which could adversely affect the safety of flight.

b. The periodic flight inspection window for all SIAP's may be extended an additional thirty (30) calendar days providing:

(1) A review of the SIAP is accomplished by a Flight Inspector and;

(2) The FICO, by coordination with regional or local airport personnel can determine that no known environmental (i.e., construction or natural growth) changes have occurred which could adversely affect the procedure and;

(3) The National Flight Procedures office agrees that an extension of the window will not adversely affect the safety of flight.

105.3 NAVAIDS Temporarily Out-of-Service.

a. Use the priority listed in paragraph 104.7 of this order when a restoration inspection is required. The next periodic inspection shall be predicated on the completion date of an inspection which satisfies all periodic checklist requirements.

b. When a portion of a NAVAID is restored to service, the periodic due dates shall be established in accordance with paragraphs 105.11 and 105.4.

c. Standby Equipment or Associated NAVAID. When flight inspection of standby equipment or an associated NAVAID is required but cannot be accomplished, the periodic inspection shall be considered complete if the standby equipment or associated NAVAID is out-of-service (awaiting parts, etc.), or removed from service (due to an uncorrectable discrepancy, etc.) The standby equipment or associated NAVAID shall be restored to service by the successful completion of a flight inspection which satisfies all periodic requirements (including monitors, where applicable).

105.4 RHO-THETA Receiver Checkpoints. When periodic or special flight inspections of ground or airborne receiver checkpoints cannot be completed, the inspection shall be considered complete. The following actions will be taken:

a. The flight crew will document the required inspection as complete on both the Daily Flight Log (DFL) and the flight inspection report. Enter in remarks those checkpoints that were not checked.

b. The FICO will:

(1) Schedule a special inspection to complete the checkpoints within the established facility periodicity.

(2) Take appropriate NOTAM action to remove the receiver checkpoints from service if the special inspection is not completed within the established facility periodicity. Notify the airport manager that the ground receiver checkpoints must be removed or covered.

105.5 Periodic Flight Inspection Intervals. The schedule for periodic flight inspections shall be in accordance with Table 105-1.

a. Establishing the Interval.

(1) Commissioning. Inspect newly commissioned precision facilities initially at a 90, 180, and 270-day interval and then maintain the schedule established in Table 105-1. For PAR, each runway served and alternate angle or touchdown point used shall be inspected on the 90 and 180-day checks. For ILS, a Periodic with Monitor check is required for the initial 90, 180, and 270-day checks. This requirement also applies to the glide slope, but not the localizer when a glide slope is added to a localizer-only or LDA/SDF facility.

(2) Specials other than reconfigurations. Facilities may be restored to the existing periodicity without further checks once the special is complete and deemed satisfactory by Airway Facilities engineering or maintenance personnel. Update the periodic due date if all system periodic requirements for the next scheduled periodic inspection are completed during any special inspection.

(3) Reconfiguration of Precision Approach Services. Reconfigured precision approach services shall initially be checked at 90 days. For ILS, a full periodic with monitor reference check on both localizer and glide slope facilities shall be scheduled as part of this special, and the periodic with monitors shall be updated on the Daily Flight Log (DFL). The next periodic due date will be at the 270-day interval. For PAR, each runway served and alternate angle or touchdown point used shall be inspected on this check.

105.51 ILS Monitor (or Reference) Intervals. Monitors (or reference) check intervals shall be twice the established (Table 105-1) facility periodic interval.

Table 105-1 Basic Schedule for Periodic Flight Inspection
(all intervals are in days)

APM	540

Precision:

Facility	Interval
ILS LDA/SDF w/ GS	270 (2)
Localizer Clearances at LCA	1,080
MLS	270
MMLS	180 (3)
PAR	270

SIAP (Precision)	540

Non-Precision:

Facility	Interval
ASR	540
DF	540
FMS	540
Localizer Clearances at LCA	1,080
RNAV/GPS	540
LDA/SDF/LOC only	540 (2)
LORAN C	540
NDB (UHF, LF/MF)	540
VOR, VORTAC, TAC	540 (1)
VOR, VORTAC, TAC	1,080 (4)
VOT	540
DME, VGSI, Marker Beacons, Communications, and Approach Lighting Systems	Inspect these facilities at the same interval as the system or procedure they support.

SIAP (Non-Precision)	Conduct at same interval as facility

Notes:
(1) 540 days for facilities which support a SIAP or receiver checkpoint. An alignment orbit is required every 1,080 days for all facilities.
(2) Monitors required every other inspection. See Paragraph 105.5.
(3) SIAP check required every 360 days.
(4) 1,080 days for facilities which do not support a SIAP or receiver checkpoint.

SECTION 106. GENERAL FLIGHT INSPECTION PROCEDURES

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SECTION 106. GENERAL FLIGHT INSPECTION PROCEDURES

106.1 INTRODUCTION. Sequence of events encountered by the flight inspector in the performance of the flight inspection mission is generally as follows:

a. Request for flight inspection

b. Preflight preparation

c. Actual flight inspection

d. Analysis and evaluation

e. Post flight review and reporting

106.2 REQUEST FOR FLIGHT INSPECTION. Site, commissioning, and some special flight inspections shall be requested by authorized personnel. Requests are not required for periodic flight inspections.

106.21 Status of Equipment. A request for flight inspection should not be initiated until all required facility equipment is installed, properly adjusted, calibrated, and operating normally.

106.22 Notification. The flight inspector or central scheduling and dispatch facility shall notify the appropriate facility maintenance personnel of the estimated time of arrival (ETA) of the flight inspection aircraft. As much advance notification as possible shall be provided for a site evaluation, commissioning inspection, periodic with monitors, or inspections requiring maintenance support.

An ILS periodic inspection without monitors does not require pre-coordination with maintenance personnel. This inspection should be conducted on the transmitter in operation. If an out-of-tolerance condition is found, notify maintenance of the discrepancy(ies) found and inspect the standby equipment. NOTAMs shall be issued if discrepancies are not corrected.

106.3 PREFLIGHT INSPECTION PREPARATION. A thorough and complete understanding between facilities maintenance personnel and the flight inspection crew is essential for a successful flight inspection. The flight inspector and the person-in-charge of the facility are jointly responsible for the required coordination before, during, and after the flight inspection. The flight inspector will brief the facilities maintenance personnel of intended actions prior to commissioning flight inspections and for special circumstances.

106.31 Facilities Maintenance Personnel. Efficient and expeditious flight inspections require preflight preparations and actions of facilities maintenance personnel. These preparations include the following actions:

a. Provide adequate two-way radio communications equipment and power source at facility sites. Two-way communication should be provided by flight inspection when a theodolite or RTT is required.

b. Ensure that all facility equipment is calibrated in accordance with technical orders.

c. Ensure personnel will be available to make corrections and adjustments.

d. Provide transportation to move flight inspection equipment and personnel.

e. Provide accurate facility data for new or relocated facilities.

106.32 Flight Personnel. The following actions shall be accomplished prior to the flight inspection:

a. Ensure that all flight inspection equipment is calibrated and operational.

b. Brief facilities maintenance personnel.

c. Conduct crew briefing.

d. Obtain maps, charts, equipment, data sheets, etc.

e. Review the status, limitations, and characteristics of the facility. Ensure that all publications and records agree with the results of the latest flight inspection, and all applicable restrictions are accurate.

f. Brief the air traffic control (ATC) personnel about the areas and altitudes to be flown during the flight inspection maneuvers and of possible transmitter changes.

106.4 FLIGHT INSPECTION. Perform the flight inspection in accordance with the procedures in Chapter 200 of this manual.

106.41 Operator Proficiency. During flight inspections, qualified personnel will be assigned so operator deviations will not be confused with equipment performance.

106.42 Standby Equipment. It is necessary to know which system or transmitter is operating so the performance of each can be determined.

a. When one unit of a dual equipped facility is found out-of-tolerance, it shall be identified and removed from service. The unit can be identified as transmitter number 1 or 2, channel A or B, serial number, etc.

b. Some inspections may only require the checking of one equipment. The details for each type of facility are included in the appropriate facility checklists.

106.43 Standby Power

a. The flight inspector shall check the facility on standby power during a commissioning flight inspection if standby power is installed. If a standby power system is installed after the commissioning flight inspection, the flight inspector shall check the facility on standby power during the next regularly scheduled periodic inspection. The flight inspector shall make comparative measurements to ensure that facility performance is not derogated on the standby power system and that all tolerance parameters for the specific inspection are met. Standby power checks are not required on facilities powered by batteries that are constantly charged by another power source.

b. It is not necessary to recheck a facility when the standby power source is changed.

106.44 On-Station Philosophy. Flight inspectors shall assist in resolving facility deficiencies and restoring the facility to service prior to departure.

106.441 Restrictions. When a facility parameter does not meet established tolerances or standards, the flight inspector shall perform sufficient checks to determine the usable area of the facility. This data will be the basis of restrictions, NOTAMs, and procedural redesign.

106.442 Spectrum Management Restrictions. Facilities assigned a spectrum management restriction will be classified as "Restricted" and shall be identified on the Facility Data Sheet. This restriction remains in effect even when the facility performance indicates no interference exists. Do not remove published spectrum management restrictions based on flight inspection results.

106.45 Adjustments. Requests for adjustment shall be specific. The flight inspection crew will furnish sufficient information to enable maintenance personnel to make adjustments. Adjustments which affect facility performance shall be rechecked by flight inspection. Flight inspection certification shall be based on facility performance after all adjustments are completed.

106.46 Incomplete Inspections. When an inspection on a commissioned facility must be halted with the equipment in an abnormal condition due to aircraft malfunction, weather, etc., maintenance personnel and the flight crew shall discuss the facility condition and the remaining checks. If the facility maintenance handbooks allow adjustments of the facility parameter without flight check, and adequate references provide the ability to return to a previously certified setting, the equipment may be returned to service. The inspection will be classified as incomplete until the remainder of the checks is completed. When a prescribed inspection checklist item cannot be adjusted within tolerance, the inspection will be terminated, facility status changed to unusable, and the inspection classified as incomplete until the remainder of the checks are completed.

106.5 ANALYSIS AND EVALUATION

a. Flight inspection data shall be analyzed and evaluated by flight inspection using the tolerances specified in this manual. Recordings made during the flight inspections are the permanent records of facility performance.

b. On request, pertinent flight recordings will be made available to facilities maintenance personnel for engineering analysis. The recordings will be preserved and promptly returned to the flight inspection unit upon completion of the analysis.

106.51 Alignment Convention. The alignment error of omni-directional type facilities (VOR, TACAN, DF, NDB, ASR, etc.) shall be computed through algebraic addition. The azimuth reference (AFIS, theodolite, map) shall always be assigned a Positive (+) value, and the azimuth determined by the ground facility shall always be assigned a Negative (-) value. Thus, with a received VOR radial value of 090.5 and an AFIS/map position of 090.0, the facility error would be –0.5°. Alignment errors may also be referred to as clockwise (positive) and counterclockwise (negative).

106.52 System Evaluations. Flight inspectors shall make maximum use of the capability of the flight inspection system. When a special inspection encompasses only one part of a system, i.e., VTAC/V, ILS/G, or MLS/A, the other parts of the system, i.e., VTAC/T, ILS/L, Markers, MLS/E, and DME shall be recorded and analyzed on a surveillance basis during appropriate maneuvers. Recorder traces that are set by default to the ON position should not be turned OFF unless they obscure other traces. No additional checks are needed to inspect the additional components, unless an out-of-tolerance condition is found, in which case the provisions of Paragraph 104.6 apply.

106.6 POST FLIGHT INSPECTION ACTIONS. Upon completion of the flight inspection, the flight inspection crew shall perform the following actions:

a. Brief facilities maintenance personnel

b. Determine facility status

c. Prescribe the issuance and/or cancellation of NOTAMs.

d. Prepare flight inspection reports

e. Ensure flight information is published

106.61 Brief facilities maintenance personnel concerning results of the flight inspection. Flight inspection shall report all facility outages to appropriate personnel.

106.62 Facility Status. Flight inspection shall assign a status for the facility (see Section 107). Flight Inspection shall also notify the appropriate personnel of the facility status.

106.63 NOTAM's. The flight inspector shall prescribe the issuance and/or cancellation of NOTAMs based on the flight inspection (see Section 107.)

106.64 Reports. Flight inspection reports shall be accurate and describe facility performance and characteristics. Reports shall be completed in accordance with FAA Order 8240.36, Instructions for Flight Inspection Reporting, latest revision.

106.65 Flight Information. The flight inspector shall provide information for publication to the Flight Inspection Technical Support Branch. The Flight Inspection Technical Support Branch will notify the National Flight Data Center.

a. Receiver Checkpoints. The following information shall be provided for receiver checkpoints:

(1) Airport name

(2) Bearing in degrees magnetic from the VOR/TACAN

(3) Location and description

(4) Distance and altitude

NOTE: Examples--

1. Ground Checkpoint. Central City, Utah, (Municipal): 130°, 4.5nm, runup pad Rwy 14.
2. Airborne Checkpoint. Mudville, Ohio, (Jones): 148°, 5.7nm, over int Rwys 20 and 13; 3,300 .

b. VOR Test Facilities (VOT). The following information shall be provided for a VOT:

(1) Facility name (and airport name)

(2) VOT frequency

(3) Type facility (area or airport)

(4) Information describing usable area

SECTION 107. FACILITY STATUS CLASSIFICATION AND NOTICES TO AIRMEN (NOTAM)

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SECTION 107. FACILITY STATUS CLASSIFICATION AND NOTICES TO AIRMEN (NOTAM)

107.1 INTRODUCTION. Air navigational and traffic control facilities are expected to be usable within specific limits of distances and altitudes (service volume). Facility status classification and NOTAMs will indicate restriction(s) to the expected use of these facilities. The facility status classification indicates the general performance of the facility as determined from each flight inspection. This classification is directed only to the maintenance and/or operating agency. The NOTAM advises the user of any restriction to facility usage.

107.2 FACILITY STATUS CLASSIFICATION. Based on the performance of the facility, flight inspection shall assign one of the following status classifications:

a. Unrestricted: The status of a facility which meets established tolerances.

b. Restricted: The status of a facility which does not meet established tolerances throughout the flight inspection standard service volume (areas shall be clearly defined as unusable in a NOTAM).

c. Unusable: The status of a facility which is unsafe or unreliable for navigation (a NOTAM shall be issued for the facility defining it as unusable).

107.21 International Facilities. The FAA performs flight inspection of international facilities on a contract or agreement basis and for NAVAIDS supporting U.S.-controlled instrument procedures. International facilities are maintained using the manufacturer's instructions manual and may have no procedures for accomplishing some checks required by this order. Checks performed under these conditions, while meeting the owning nation's procedural and maintenance certification requirements, do not encompass all checklist items required of U.S. facilities. Special procedures apply for checks performed under these conditions.

a. For facilities for which the FAA has flight inspection responsibility, and **all checklist items** appropriate for the inspection **have been completed**, the flight inspector shall assign a facility status.

b. For facilities for which the FAA has flight inspection responsibility, and all checklist items appropriate for the inspection have **not been completed,** the flight inspector shall discuss the uncompleted items with the facility manager and annotate the report with a statement that the assigned status applies only to the ICAO Annex 10 signal requirements in the as-left configuration. The assigned facility status shall be as applied to usability.

c. If the check does not meet the requirements of this order or ensure the standards of ICAO Annex 10, the host nation shall assign the facility status.

d. For facilities inspected only to the extent that they support U.S. instrument procedures, no status shall be assigned, and the report shall be annotated as to the limited inspection.

e. If any checklist items are not completed, they shall be listed on the report.

107.22 Facility Coverage in Limited Areas. When facility coverage throughout the flight inspection standard service volume cannot be checked due to inability to penetrate national borders or restricted airspace, the facility shall be classified as RESTRICTED, with the report annotated as to the limited coverage flown. NOTAM and publications action shall show the facility as UNUSABLE in the areas not checked.

107.3 NOTAM's.

a. Facility NOTAM's. The flight inspector shall immediately initiate NOTAM action whenever a facility restriction is found or revised. FAA Order 7930.2, Notices to Airmen (NOTAM) Handbook (latest edition), and the instructions in this order shall be used to issue NOTAM's. An FDC FI NOTAM shall be issued if a restriction affects instrument flight procedures, approach minimums, or category (CAT) II or III authorizations. To initiate NOTAM action, advise the appropriate Flight Service Station (FSS) or Military Base Operations (for Army facilities, notify the ATC Facility Chief). Recommend a NOTAM be issued defining the restrictions found. The flight inspector shall verify that the appropriate NOTAM's were issued correctly within 24 hours.

The flight inspector shall verify that the correct NOTAM is published in the appropriate agency publications.

b. Instrument Flight Procedures. The flight inspector shall coordinate NAVAID NOTAMs with the procedures specialist, as restrictions to NAVAIDs may affect published instrument flight procedures. The procedures specialist shall:

(1) Determine what published instrument flight procedures are affected.

(2) Initiate appropriate NOTAMs that amend or suspend those procedures by calling the National Flight Data Center (NFDC), Flight Procedures/Airspace Section, ATA-100, for civil and Army facilities, (for other military facilities, notify the appropriate Military Base Operations).

NOTE: During NFDC non-duty hours (1700-0800 eastern), the FDC NOTAM is to be forwarded to the NOTAM office (ATA-100).

(3) Review the NAVAID restrictions to determine what effect they will have on the instrument flight procedures. The central scheduling and dispatch facility will ensure that the required NOTAMs are immediately transmitted to NFDC. If the procedures specialist is not available, the flight inspector shall verify that any required NOTAMs are issued.

c. Facilities not requiring NOTAMs. Do not issue a NOTAM to reflect restrictions found during the flight check of radar or direction finding facilities; however, review the instrument flight procedures to ensure that those requiring ground radar are amended or suspended. Coordinate this action with the procedures specialists.

d. Expanded Service Volume (ESV) Facilities. When a facility no longer supports an ESV, the facility is not restricted, but a NOTAM must be issued for the instrument flight procedures predicated on that ESV. Coordinate and publish the newly established ESV and instrument flight procedures.

e. Out-of-Tolerance Standby Equipment. Where one of two transmitters of a facility is restricted due to out-of-tolerance parameters and the other is satisfactory, the satisfactory transmitter may be operated without a NOTAM. However, NOTAM data describing the restriction shall be provided to facilities maintenance personnel. In the event the restricted transmitter is used, the operating agency shall issue the NOTAM.

107.31 NOTAMs on Military Facilities (including ships).

a. The military installation commander has the final authority and responsibility for NOTAM issuance and for facility operations of all military facilities which are not part of the National Airspace System (NAS). The commander may elect to use "For Military Use Only" facilities found unsatisfactory for continued NAS usage.

b. The flight inspector will recommend NOTAMs to the military commander's representative (see paragraph 107.34) when facilities under the commander's jurisdiction require NOTAM action.

c. NOTAMs shall not be issued on shipboard facilities.

107.32 Preparation of NOTAMs

a. NOTAMs shall include facility name, type, component, and the unusable area/altitude. The absence of a specific altitude or distance will denote all altitudes and distances. It is important to include specific information to avoid confusion. The reason for the restriction, e.g., lack of signal, frequency interference, course structure, alignment, unlocks, etc., serves no useful purpose and shall not be included in the text of the NOTAM.

b. Restrictions to TACAN azimuth are not included in agency publications, but are referred to the military for dissemination as they consider necessary. A copy of each NOTAM issued or recommended for TACAN azimuth restrictions shall be retained in the facility file for reference during subsequent flight inspections. The NOTAM preparation for the TACAN azimuth component of a VORTAC is identical to the VOR.

107.33 Facility Restrictions. Apply the following rules for restricted facility use:

a. Describe the radials or bearings that are unusable.

b. Describe the altitude and mileages that are unusable.

c. VOR/TACAN/VOT/DME/DF/NDB/ASR. Describe radial/bearing from the station in a clockwise (CW) direction, altitude in terms of **above** or **below** an MSL altitude, and distance in terms of **beyond** or **within** a nautical mile distance.

d. Localizer/LDA/SDF/TLS Azimuth. Describe laterally in terms of degrees left or right of inbound course and in nautical miles from threshold if the restriction affects the limit of usable signal closest to the threshold. Use distance in nautical miles from the antenna to describe restrictions affecting the usable distance of the facility. Describe altitude in terms of above or below an MSL altitude. Additional reference to DME distances may be used if the DME is part of the SIAP.

e. Glide Slope/TLS Elevation. Describe in terms of degrees left or right of inbound course and nautical miles from threshold; restrictions pertaining to altitude shall be in terms of above or below an MSL altitude. Ensure the restriction correctly reflects the service volume origin (see Paragraph 217.241 and Figure 217-7). Additional reference to DME distances may be used if the DME is part of the SIAP.

f. MLS. Describe in azimuth terms of inbound magnetic courses, using clockwise (CW) references, starting at the restricted portion closest to the inbound right-hand edge of the service volume. Describe elevation terms in degrees when restricting an entire azimuth sector and in terms of feet MSL when restricting a sector beyond a distance. Define elevation restriction affecting decision height in feet MSL. Define distances in DME.

g. Published NOTAM's will usually omit the CW reference. This does not constitute an erroneous NOTAM. Published NOTAM's and restrictions shall be reviewed by the flight inspector to ensure they convey the correct meaning.

107.34 NOTAM Examples. The following are examples of conditions and prescribed NOTAMs:

a. Condition 1. All components of a VORTAC are unusable in a specific sector due to out-of-tolerance VOR and TACAN course structure and unusable DME. **NOTAM**, Chicago VORTAC: VOR, DME, and TACAN azimuth unusable, 025 cw 075° beyond 25 nm below 3,500 feet.

b. Condition 2. A VOR does not provide adequate signal to 40 miles at the required altitudes in various areas. **NOTAM** Altoona VOR: VOR unusable, 080 cw 100° beyond 18 nm below 3,500 feet; 101 cw 200° beyond 30 nm below 3,500 feet; 201 cw 300° beyond 30 nm below 4,500 feet; 301 cw 350° beyond 15 nm; 351 cw 010° beyond 30 nm below 4,000 feet.

c. Condition 3. VOR is unusable in various areas below one altitude. Also, the DME is unusable in one sector. **NOTAM,** Yardley VORTAC: VOR unusable below 1,700 feet in the following areas: 250 cw 265° beyond 17 nm; 266 cw 280° beyond 10 nm; and 281cw 290° beyond 17 nm. DME unusable 225 cw 275° in the following areas: Beyond 15 nm below 2,400 feet and beyond 30 nm below 5,000 feet.

d. Condition 4. A Nondirectional radio beacon is not usable in the Southeast quadrant. **NOTAM** Bradford NDB: unusable 090 cw 180° beyond 15 nm.

e. Condition 5. Glide slope tolerances are exceeded at a specific point on the glidepath. **NOTAM**, Ashville Regional, NC: Rwy 16 ILS glide slope unusable below 2,310 feet MSL.

f. Condition 6. An ILS localizer exceeds tolerances at 1/2 mile from the runway threshold. **NOTAM,** Hartsville Muni, SC, Rwy 16 ILS unusable from 1/2 nm inbound.

g. Condition 7. Cat II ILS ceases to meet CAT II criteria. FDC, FI/(P or T), **NOTAM** William B. Hartsfield, Atlanta Int'l, GA: ILS Rwy 9R, CAT II NA.

NOTE: FI/P means permanent and FI/T means temporary flight information.

h. Condition 8. CAT III ILS localizer exceeds CAT III tolerances in Zone 4. **FDC, FI/P NOTAM** Charleston AFB/Int'l SC: Rwy 15 ILS, CAT III NA.

i. Condition 9. CAT II ILS localizer exceeds tolerances in Zone 4. **NOTAM,** New Orleans Int'l, LA: Rwy 28 ILS LOC unusable inside runway threshold.

NOTE: The localizer is unrestricted.

j. Condition 10. CAT III ILS localizer exceeds tolerances in Zone 5. **NOTAM,** New Orleans Int'l, LA: Rwy 28 ILS LOC unusable for rollout guidance.

k. Condition 11. Glide slope does not meet change/reversal tolerances below a point on the glidepath. **NOTAM,** Ashville Regional, NC: Rwy 16, ILS glide slope unusable for coupled approaches below 2,000 feet MSL.

l. Condition 12. Localizer does not meet tolerances in the vertical plane. NOTAM, Wellsville Municipal Arpt., Tarantine Field Arpt., Wellsville, NY: ELZ LOC Rwy 28, LOC unusable beyond OM above 3,500, at threshold above 500.

m. Condition 13. Beyond 5° left of LOC course, there are no glide slope clearances above path, and a glidepath is not provided. NOTAM, Charlotte/Douglas Int'l, NC: Rwy 36R ILS glide slope unusable beyond 5° left of LOC course.

n. Condition 14.

(1) MLS Azimuth Unusable. Because an unusable approach azimuth renders the elevation unusable, refer to any unusable azimuth segment as "MLS unusable". Describe the limits using **inbound courses;** e.g.:

(a) UMP MLS unusable 196 cw 206°.

(b) UMP MLS unusable 196 cw 206° below 4°.

(c) UMP MLS unusable 196 cw 206° beyond 15 DME below 4,000 feet MSL.

(2) Elevation. Refer to any unusable segment as "MLS elevation unusable"; e.g.,

(a) UMP MLS elevation unusable 151 cw 156° below 3.5°.

(b) UMP MLS elevation unusable 151 cw 156° beyond 15 DME below 7,000 feet MSL.

(3) MLS DME unusable. Refer to any area of unusable DME as "UMP MLS DME unusable".

107.35 Required Advisories for Local NOTAMs. The flight inspector shall notify Air Traffic (AT) personnel when the facility is not authorized for use because of flight inspection actions.

SECTION 108. RECORDS AND REPORTS

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SECTION 108. RECORDS AND REPORTS

108.1 Introduction. This section provides policy for flight inspection reports and records. All digital analog and pictorial data provide the basis for real-time certification of the quality of signal in space. The flight inspection report provides permanent, historical interpretation of a system's performance. The report shall accurately reflect the operational status of the system, the quality of the signal in space, and the instrument flight procedure it supports.

108.2 Records. Flight inspection files are Federal record material. The standards for their retention and destruction are contained in FAA Order 1350.15, Records Organization, Transfer, and Destruction Standards. A facility Reconfiguration (Special/RF) inspection that meets all the commissioning requirements is considered a Commissioning type inspection for record keeping purposes. Flight reports of flight inspection aids to air navigation, as well as recorder charts, inspection worksheets, polar plots of coverage patterns, error curve graphs, and related correspondence, constitute report files. Other material may include data items which are necessary for flight inspection purposes, such as horizon profiles, site drawings, topographic charts, instrument approach/ departure procedure charts, photographs and data sheets, aircraft logbooks, etc.

a. General Information. Ensure that any information that is included in the facility file is annotated with the following information:

(1) Facility identification/type of facility
(2) Date(s) of inspection
(3) Type of inspection, e.g., periodic, etc.
(4) Aircraft tail number
(5) Crew initials and numbers
(6) Recorder calibration
(7) Equipment-required flight inspection self-test

108.21 Facility Data Sheets. The flight inspector shall ensure that the facility data reflects the most current information and is sufficient to complete the flight check requirements.

108.3 Reports. The flight inspection report serves as the primary means of documentation and dissemination of the results of each flight inspection. Requirements for the use, completion, and distribution of standard FAA and suitable military flight inspection forms are contained in FAA Order 8240.36, Instructions for Flight Inspection Reporting (latest revision).

108.31 Military Facilities

a. Changing a Facility Classification to Restricted or Unusable or Altering a Restriction. When the results of the flight inspection indicate that the facility classification is to be changed to "restricted" or "unusable" or that facility restrictions have changed, land the aircraft, if practical, and discuss the reasons and recommended action with appropriate representatives of the base commander. If it is impractical to land, give a status report to the control tower (on ground or tower frequency) indicating the exact status of the facility (unrestricted, restricted, or unusable) and all discrepancies found. Provide them with suggested wording for any required NOTAM's (see Section 107). Request acknowledgement of the information.

b. Where there has been no change in facility performance, inform the control tower (on ground or tower frequency) of the exact facility classification. Again, request acknowledgement.

c. If a military installation does not have a control tower, attempt to pass the information over any other available air-to-ground frequency that would ensure dissemination of the flight check results. If no appropriate air-to-ground frequency is available and it is impractical to land, telephone the appropriate personnel as soon as possible.

d. In any of the above cases, inform the appropriate military maintenance personnel of any discrepancies discovered, and the resulting facility classification.

108.32 Reports Submitted by Military Flight Inspectors.

a. Flight inspection reports of facilities inspected by military flight inspection crews, who have been delegated the authority for execution of the flight inspection mission, shall be accepted by the FAA as official flight inspection reports.

b. Military flight inspectors shall assign a classification or status to those facilities for which they have flight inspection responsibility.

NOTE: Coordination may be in the form of a letter of agreement or may be handled on a case-by-case basis. Coordination with AVN constitutes full flight inspection authority for the respective facility.

SECTION 109. MILITARY EMERGENCY AND NATURAL DISASTER FLIGHT INSPECTION PROCEDURES

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SECTION 109. MILITARY EMERGENCY AND NATURAL DISASTER FLIGHT INSPECTION PROCEDURES

109.1 Introduction. The potentially catastrophic consequences of a major natural disaster or the need to respond quickly to a military emergency necessitate advanced planning and definition of operational requirements. In such circumstances, military flight inspection resources will become critical in the restoration of navigational aids. The ability to provide sustained flight inspection support for the numerous and diverse requirements which may exist will be predicated upon the use of abbreviated flight inspection procedures. Flight inspection will greatly depend on both air traffic and facility maintenance support preparations.

109.11 Purpose. The guidance, procedures, and tolerances contained in this section describe the minimum facility performance standards when emergency situations require deviation from normal standards. Basic flight inspection requirements and methods of taking measurements apply to the emergency section unless specific guidance or tolerances are given. Facilities which have been placed in operation using these procedures shall be re-inspected to normal standards when circumstances permit.

109.12 Authority

a. The authority to implement these provisions may be exercised by either military or FAA. When military authority determines that an operational situation dictates the application of these procedures and tolerances, the appropriate flight inspection activity and the FAA Aviation System Standards Office (AVN) Manager, Flight Inspection Operations Division, AVN-200, shall be notified. Application to civil facilities will be determined by appropriate FAA authority, who shall notify both AVN-200 and appropriate military authority. The Flight Inspection Operations Division, AVN-200, is responsible for issuing a General Notice (GENOT) and initiating a Notice to Airmen (NOTAM) regarding implementation of abbreviated procedures to provide facilities for emergency use.

b. Flight inspection personnel, performing facility inspection and certification using the provisions of this section, must be authorized and qualified to perform flight inspection duties.

109.2 Preflight Requirements.

109.21 Aircraft and Equipment.

a. If necessary, equipment which has exceeded calibration due dates may be used for emergency flight inspection. Calibrated equipment shall be used when the facility is subsequently inspected using standard procedures.

b. The use of other than a flight inspection-configured aircraft may be necessary. Reliability of such equipment shall be established before use by the flight inspector. Examples of test methods available to verify the accuracy of uncalibrated flight inspection systems or aircraft not equipped with a flight inspection system are:

(1) Comparison with a facility verified by maintenance, or another flight inspection aircraft, as operating normally.

(2) Comparison with two or more facilities in operation.

(3) Use of a VOT or similar radiated test signal.

109.22 Types and Priorities of Emergency Flight Inspection.

a. Only special and commissioning type flight inspections (reference Section 104) will be conducted under emergency conditions using the procedures contained in this section. After-accident flight inspections may also be conducted under emergency conditions, but normal procedures shall be followed.

b. Priorities shall be established at field level if mutual agreement can be reached. Conflicts will be resolved by AVN-200.

109.23 Pre-inspection Requirements

a. Prior to arriving on location, the flight inspector or central scheduling and dispatch facility shall contact the air traffic control manager and the facility maintenance supervisor in order to coordinate the following items:

(1) Arrival time

(2) Emergency operational requirements as defined by the air traffic control manager.

(3) Airspace requirements for conducting the flight inspection profile.

(4) Anticipated support such as refueling, ground transportation for a theodolite operator, etc.

b. The air traffic control manager shall accomplish the following prior to arrival of the flight inspection aircraft.

(1) Make final determination regarding emergency operational requirements for the facilities and SIAP's requiring flight inspection, and be prepared to brief changes on initial contact.

(2) Coordinate airspace requirements and obtain necessary clearances from appropriate airspace control authorities for conducting the inspection.

(3) If required, designate and brief an air traffic controller to work the flight inspection aircraft.

(4) Provide current facility data (FAA Form 8240-22) for each facility to be inspected.

c. The facility maintenance supervisor shall:

(1) Ensure adequate radio communications are available and operational.

(2) Assigned qualified maintenance personnel to support the flight inspection of the equipment being inspected.

(3) Assist the Air Traffic Control Manager in completing FAA Form 8240-22 (Facility Data Sheet) for each facility to be inspected.

(4) Arrange for ground transportation for the theodolite operator if necessary.

109.3 Approach Procedures

a. The minimum flight inspection required to certify published SIAP's is the inspection of the final approach and missed approach segments.

b. If an approach must be established, the flight inspector may be responsible for establishing final and missed approach procedures. Both segments of the procedure shall be flown and recorded to establish and document flyability, accuracy, reliability, and obstacle clearance. The flight inspector shall record the emergency SIAP procedures on the flight inspection report and provide the air traffic control watch supervisor with adequate detail for issuance of the NOTAM.

c. In all cases, the flight inspector shall determine, through visual evaluation, that the final and missed approach segments provide adequate terrain and obstacle clearance.

109.4 En route and Transition Coverage. If there is a need for facility coverage to provide en route and transition to terminal environment guidance, air traffic control shall use aircraft of opportunity to fly the transition procedure. Pilot reports of satisfactory cockpit instrument performance and controller evaluation of radar target strengths are sufficient for air traffic control to determine usability.

109.5 Facility Status and NOTAM's

a. Prior to beginning the inspection, the flight inspector shall ascertain from air traffic control the intended operational use of the facility. After completing the inspection, the inspector shall determine the facility status for emergency use and advise the air traffic control watch supervisor prior to departing the area.

b. Upon being advised of the status, the air traffic control watch supervisor shall ensure issuance of a NOTAM. Unusable SIAP's, or portions thereof, shall be included in the NOTAM (e.g., ELP VOR and TACAN: VOR SIAP runway 26L unusable TACAN SIAP runway 26L unusable). The NOTAM for a civil facility must be issued as a NOTAM D to ensure that information is made available using the most expeditious method. Therefore, NOTAM's which are lengthy and describe emergency-use NAVAID's in great detail will not be issued. The flight inspector shall subsequently record the NOTAM text in the remarks section of the applicable flight inspection report.

c. The flight inspector has the authority and responsibility for determining that a NAVAID can safely and adequately support the operations intended under emergency conditions. However, military installation commanders have final authority and responsibility for operation of military facilities which are not part of the common system, and may elect to use those facilities FOR MILITARY MISSIONS. Additionally, the military may elect to use a military or civil NAVAID, which is part of the common system, even though that NAVAID is considered unusable by the flight inspector. In all such cases, the military installation commander is responsible for issuance of an appropriate NOTAM advising that the NAVAID is in operation "For Military Emergency Use Only" to support emergency operations.

109.6 Flight Inspection Documentation and Reports

a. Flight inspection recordings shall be retained until the facility can be inspected using normal procedures and tolerances. In the event that flight inspection equipment is inoperative or not available, flight inspections will continue to meet emergency operational requirements until replacement or repair is practical. Under these circumstances, the flight inspection pilot and airborne electronic technician are jointly responsible for documenting all of the applicable data displayed by instrumentation at their crew duty positions. All such manually-acquired data shall be identified in the remarks section of the flight inspection report. The facility/SIAP shall be reflown with operational flight inspection equipment when conditions permit.

b. Completion and distribution of flight inspection reports are secondary to the accomplishment of emergency flight inspection. At the conclusion of the inspection, the flight inspector shall pass the facility status to the air traffic control watch supervisor on an air traffic frequency. This will suffice as the official report until the written report has been completed and distributed.

c. The flight inspector shall ensure that flight inspection reports are completed and submitted for processing. Each parameter specified in the emergency flight inspection procedures checklists contained herein shall be reported. Flight inspection reports may be handwritten using reproducible ink.

d. Recordings and reports shall reflect that the inspection was accomplished using MILITARY EMERGENCY AND NATURAL DISASTER FLIGHT INSPECTION PROCEDURES.

109.7 Flight Inspection Procedures/ Tolerances.

109.71 ILS Glide Slope.

Checks Required	**Tolerances/Procedures**
Modulation	The modulation and carrier energy level is such that the flag is hidden in the area identified as usable.
Angle	$\pm$ 0.5^0 of desired or commissioned angle.
Coverage	Minimum 15 microvolts signal, 2 NM outside OM of FAF and 150 microvolts
Clearance	Minimum 150*u*A (full scale) fly up and clear all obstructions prior to 1000' from threshold
Course Structure	45*u*A from graphical average for all zones if restricted to manual approaches. Standard tolerances apply if used for coupled approaches.
Flyability	Any condition that may induce confusion will render the facility unusable.
PAR Coincidence	0.2^0. If PAR/ILS coincidence cannot be established, a NOTAM shall be issued.

NOTE: These tolerances and procedures are valid for Category I minimums only. If operational requirements dictate the restoration/commissioning to Categories II or III standards, thflight inspector shall use normal procedures (see Section 217).

109.72 ILS--LOCALIZER

Checks Required	**Tolerances/Procedures**
Identification	Sufficient information to identify the facility. ID shall not render the facility unusable.
Modulation	The modulation and carrier energy level is such that the flag is hidden at all times in the area identified as usable.
Coverage	15 NM minimum coverage area with 5*u*V minimum signal, not less than 10^0 each side of on-course position.
Course Structure	$\pm$45*u*A from graphical average for all zones if restricted to manual approaches. Standard tolerances apply if used for coupled approaches.
Alignment	30*u*A from designated procedural azimuth.
Clearance	150*u*A minimum throughout established coverage area
Obstructions	Evaluate obstruction effect on procedure
Flyability	Any condition that may induce confusion will render the facility unusable.
Polarization	$\pm$30*u*A

NOTE: These tolerances and procedures are valid for Category I minimums only. If operational requirements dictate the restoration/commissioning to Categories II and III standards, the flight inspector shall use normal procedures (see Section 217).

109.73 Markers/Beacons

Checks Required	Tolerances/Procedures
Identification/	Correct/sufficient to illuminate the proper bulb modulation
Coverage	
Major Axis	Not less than ± 1/3 HSI deflection
Minor Axis	
Outer marker	3000' ±2000'
Middle marker	No limit
Inner marker	No limit
Fan marker	3000' ±2000' if used for obstacle clearance; otherwise, no limit

NOTES: These tolerances and procedures are valid for Category I minimums only.

If an operational marker or beacon is not available for establishing aircraft position in relation to runway threshold, other methods of position identification (DME fix, radar fix or crossing radial) may be substituted.

109.74 VOR/TVOR

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility. ID shall not render any parameter unusable.
Sensing and Rotation	Correct
Polarization	$\pm 4.0^{o}$
Modulation	AM: 25 to 35% FM Deviation Ratio: 14.8-17.2 9960: 20 - 35% with voice 20 - 55% without voice
Approach	Alignment within $\pm 2.5^{0}$. Structure not to exceed $\pm 6.0^{0}$. Inspect from FAF to MAP.
Missed Approach	Meets flyability constraints until clear of obstructions and course is established.
En Route	Alignment within $\pm 4.0^{0}$. Structure not to exceed $\pm 6.0^{0}$.
Monitors	To be set and checked by maintenance. Flight inspection will verify when practical.
Standby Equipment	Will be checked by transmitter change on approach and en route radials.
Coverage	Sufficient to support requirements.
Flyability	Any condition that may induce confusion will render the procedure or facility unusable.
Voice	Voice shall not render any parameter unusable.

Crosspointer, FLAG, and AGC shall be checked during all flights to and from the facility or starting point of the inspection.

Alignment orbit, coverage orbit, transmitter differential, and inspection of radials 5^{o} each side of final approach radial are not required.

Final approach segments may be inspected inbound or outbound.

109.75 TACAN

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility. ID shall not render any parameter unusable.
Sensing and Rotation	Correct
Polarization	$\pm 4.0^{0}$
Distance Accuracy	3% of charted value or 1.0 NM, whichever is greater
Approach	Alignment within $\pm 2.5^{0}$. Structure not to exceed $\pm 6.0^{o}$. 1/4 NM aggregate azimuth, DME unlock, or out-of-tolerance structure permitted. Inspect from FAF to MAP.
Missed Approach	Meets flyability constraints until clear of obstructions and course is established.
En Route	Alignment within $\pm 4.0^{0}$. Structure not to exceed $\pm 6.0^{o}$. 1.0 NM aggregate azimuth, DME unlock, or out-of-tolerance structure permitted in any 5NM of radial flight.
Monitors	To be set and checked by maintenance. Flight inspection will verify when practical.
Standby Equipment	Will be checked by transponder change on approach and en route radials
Coverage	Sufficient to support requirements.
Flyability	Any condition that may induce confusion will render that procedure or facility unusable.

Crosspointer, FLAG, and AGC shall be checked during all flights to and from the facility or starting point of the inspection.

Alignment orbit, coverage orbit, transmitter differential, and null checks are not required.

Final approach segments may be inspected inbound or outbound.

109.76 Shipboard TACAN

a. Emergency flight inspection procedures will normally be conducted by the Navy. Flight inspections to support specific missions will be requested by the Battle Group Commanders. Deployed ships requiring flight inspection should be positioned within 100 miles of a friendly airfield capable of supporting flight inspection aircraft. This positioning will aid mission completion within the operating service range of the flight inspection aircraft.

b. The flight inspection profile will include inspection of the approach radial from 20 NM to 3/4 NM. Any radial may be inspected outbound from approximately 10 NM while the ship makes required turns for stabilization check.

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility. ID shall not render any parameter unusable.
Sensing and Rotation	Correct
Polarization	±4.0
Distance Accuracy	3% or 1.0 NM, whichever is greater
Approach	Alignment within ±2.5°. Structure not to exceed ±6.0°. 1/4 NM aggregate azimuth, DME unlock, or out-of-tolerance structure permitted. Inspected from FAF to MAP.
En Route	Alignment within ±4.0°. Structure not to exceed ±6.0°. 1.0 NM aggregate azimuth, DME unlock, or out-of-tolerance structure permitted in any 5 NM of radial flight.
Equipment Stability	Stability will be checked during radial inspection by requesting the ship to turn left 15° and then right 15°. Advise the ship's personnel of any change in azimuth or alignment during the turns (reference 203.7h1).
Standby Equipment	Will be checked by transponder change on approach and en route radials
Flyability	Any condition that may induce confusion will render that procedure or facility unusable

109.77 PAR

Checks Required	Tolerances/Procedures
Course Alignment	Sufficient to guide an aircraft down the runway centerline extended, within ±50' of runway centerline at threshold. Helicopter-only approaches require delivery to within 50' either side of desired touchdown point.
Glidepath Alignment	±0.5° of the commissioned angle. If PAR/ILS coincidence (±0.2°) cannot be established, a NOTAM shall be issued.
Lower Safe Limit	Clear all obstacles to threshold
Coverage	Sufficient to meet operational requirements.
Range Accuracy	5% of true range and sufficient to determine when aircraft is over threshold
Flyability	Any condition that may induce confusion will render the facility unusable.

109.78 ASR/ATCRBS RADAR

Checks Required	Tolerances/Procedures
Azimuth Accuracy	En route--within ±5° Approaches: 1. Straight-in within 500' of the edges of the runway at the MAP. 2. Approach to airport/ circling within a radius of the MAP which is 5% of the aircraft-to-antenna distance or 1000', whichever is greater.
Range Accuracy	Approach and en route within 5% of fix-to-station distance or 500' whichever is greater.
Coverage	Sufficient to support requirement. Targets of opportunity may be used by air traffic personnel. Standard vertical and horizontal coverage profiles not required.

109.79 DF Facilities

Checks Required	Tolerances/Procedures
Same as standard	See Section 212

109.80 Homing Beacons

Checks Required	Tolerances/Procedures
Identification	Sufficient information to identify the facility.
Coverage	En route--±15° needle swing. Approach--±10° needle swing. Sufficient signal to support required use.
Station Passage	Approximately over the station at all altitudes
Flyability	Any condition that may induce confusion will render the procedure or use unusable.

109.81 Communications. Conduct communications inspection concurrently with other inspections. User aircraft may be used.

109.82 Microwave Landing System.

Checks Required	Tolerances/Procedures
Horizontal Coverage	5° each side beyond procedural use at 3 nm beyond procedural use
Vertical Coverage	3 nm beyond furthest procedural use at 0.75 MGP
Alignment/Angle	0.10° from optimum
Path Following Error	AZ 0.50°/EL 0.40°
Control Motion Noise	Approach AZ/MGP 0.30°, if used for manual approaches. Standard tolerance for coupled use. Other areas, 0.8°.
Low Angle EL Clearance	Fly 0.75 MGP, adequate AZ and EL guidance and obstruction clearance FAF to MAP on procedural AZ, observe each side for obstructions within 2° laterally.
Data Words	Multiply acceptable tolerances contained in Paragraph 220.54 by a factor of 3.0.
DME	No unlocks in final approach segment, accuracy 3.0% of charted distance.
IDENT	Correct as published
PAR/ILS Angle Coincidence	0.20°. If coincidence cannot be established, a NOTAM shall be issued.

SECTIONS 110 - 199

RESERVED

CHAPTER 200. FLIGHT INSPECTION PROCEDURES

200.1 INTRODUCTION. Section 200 of this manual contains the specific flight inspection procedures for the individual facilities. Each procedure is subdivided for ready reference in the following manner:

2XX Facility Name

2XX.1 Introduction

2XX.2 Preflight Requirements

2XX.21 Facility Maintenance Personnel

2XX.22 Flight Personnel

2XX.3 Flight Inspection Procedures

2XX.31 Checklist

2XX.32 Detailed Procedures

2XX.4 Analysis

2XX.5 Tolerances

2XX.6 Adjustments

2XX.7 Records, Reports, and Notices to Airmen (NOTAM)

200.11 Units of Measurement.

a. All references to miles in this manual are in terms of nautical miles (NM). All bearing, heading, azimuth, and direction information and instructions are given in degrees relative to magnetic north, unless otherwise stated.

b. References to airspeeds are true unless otherwise stated. Air and ground speeds are given in and reported in knots. Altitude references are absolute (height above the site or terrain) unless otherwise stated.

SECTION 201. RHO and THETA SYSTEMS

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SECTION 201. RHO and THETA SYSTEMS

201.1 INTRODUCTION. Rho and Theta Systems include VOR, DME, and TACAN.

201.2 PREFLIGHT REQUIREMENTS.

201.21 Facilities Maintenance Personnel. Prepare for flight inspection IAW Section 106.

201.22 Flight Personnel. In addition to the preparation outlined in paragraph 106.32, the flight inspection personnel shall prepare charts, plot the position of the facility, and depict the orbit and radial checkpoints that will be used during the evaluations.

201.3 FLIGHT INSPECTION PROCEDURES.

a. An approved automated flight inspection system (AFIS) is the preferred method for conducting a facility flight inspection using procedures contained in appropriate agency directives. When using the AFIS to evaluate actual alignment of orbits or radials, the two following updating methods may be used.

(1) Global positioning system (GPS) hybrid or equivalent (5 nm and beyond)

(2) Distance measuring equipment (DME) (10 nm and beyond)

b. When AFIS is not available, the evaluation procedures specified in this section shall be used.

c. When using a theodolite to evaluate facility performance, it shall be positioned and operated by a certified operator. The theodolite azimuth bearings shall be referenced to magnetic bearings "from" the facility (paragraph 201.43).

201.31 Checklist. The checklist prescribes the items to be inspected on each specific type of inspection. When evaluating airways or expanded service volumes (ESV's) of a VORTAC or VDME, both VOR and TACAN/DME shall be recorded. When inspecting a VORTAC that has published VOR SIAP's, but no published TACAN SIAP's, record both the VOR and TACAN data, but report only the VOR data. Due to antenna nulling, the TACAN azimuth may not support an approach that is satisfactory for VOR use. This inability to support a TACAN approach should not incur a facility restriction. A TACAN restriction would be appropriate if level flight is not supported in a given area. If a TACAN parameter is found out of tolerance within the flight inspection standard service volume, a facility restriction and NOTAM shall be required. Victor airways connect VOR, VORTAC, and VOR/DME stations and are predicated on VOR signals. When evaluating an airway of a VORTAC, do not deny the use of a Victor airway due to an out-of-tolerance value found on the TACAN azimuth or DME.

RHO AND THETA SYSTEMS FLIGHT INSPECTION REQUIREMENTS

CHECK	REF. PARA	SITE EVAL.	COMM	PERIODIC	ANTENNA CHANGE (10)	FREQUENCY CHANGE	GROUND REF ALIGN (3)	MAGVAR CHANGE	FACILITY ROTATE (2)
Reference Radial Check	201.3201 201.32041		X	X	X, (8)	X		X	X
Monitors	201.3202		(3)		(3)	(3)	(3)	(3)	(3)
Radials	201.3203 201.32041		(9) X		(9)	(9)			
Intersection/Fixes Radials	201.32031 201.32041		X	(5)	(5)	(5)		(5)	(5)
Terminal Radials	201.3204 201.32041	X	X	X, (6)	X, (6)	X		X, (6)	X, (6)
Orbits	201.3205								
Coverage	201.32052	X	X		(3), (7)	X			
Alignment	201.32051	X	X	(1)	X	X	X	X	X
Differential	201.3205		X		X			X	X
Ground Receiver Checkpoints	201.3207 201.32071		X	X	X, (8)	X		X	X
Airborne Receiver Checkpoint	201.3207 201.32072		X	X	X, (8)	X		X	X
Standby Transmitters	201.3208 106.42		X	X	X, (8)	X	X	X	X
Standby Power	201.3209 106.43		X						
Associated NAVAIDs	201.3210		X	X	X	X		X	X
Identification	201.41		X	X	X	X	X	X	X
Voice	201.42		X	X	X	X		X	X
Sensing and Rotation	201.43	X	X	X	X	X	X	X	X
Course Sensitivity/ Modulation	201.44	X	X	X	X	X	X	X	X
Polarization (one XMTR only) (4)	201.45	X	X	X	X	X		X	X
Frequency Interference	201.46 201.32041	X	X	X	X	X		X	X
Course Structure	201.47	X	X	X	X	X	X	X	X
Signal Strength	201.48	X	X	X	X	X	X	X	X
DME	201.49	X	X	X	X	X	X	X	X

FOOTNOTES:

(1) An alignment orbit (.32052) is required for all facilities every 1,080 days, including those facilities which do not support a SIAP or receiver checkpoint.
(2) Required if facility rotation is more than one degree. See Paragraph 201.32051e for exceptions.
(3) Maintenance request.
(4) TACAN requirement – Check and report polarization on at least one radial.
(5) Fixes depicted on a SIAP in final approach segment shall be evaluated concurrently with the SIAP.
(6) Check final approach segment of the SIAP(s). SID(s), STAR(s), and DP(s) are not required.
(7) First time replacement with a new type antenna, such as a Low Power TACAN Antenna (LPTA) or DOD OE-258 electronic antenna requires a coverage orbit.
(8) Evaluate on DME antenna change (same type antenna).
(9) ESV's shall be revalidated anytime a coverage orbit is performed.
(10) Also applies to a RANTEC TACAN Modulation Generator change.

201.32 Detailed Procedures. Prior to performing the checks listed below, sensing and rotation must be verified (see paragraph 201.43)

201.3201 Reference Radial Check.

a. A reference radial shall be established when establishing an orbital reference in accordance with Paragraph 201.3205 and evaluated during subsequent checks. An approach radial is recommended as the reference. When the evaluation is accomplished using an AFIS segment, the aircraft shall be coupled to the programmed RNAV azimuth and evaluated on at least a 5 nm segment between 10 and 25 nm (5 – 25 nm in hybrid mode). If non-AFIS techniques are used, the radial should lie over a well-defined ground checkpoint or theodolite bearing. When course roughness and scalloping occur during an alignment evaluation, the graphic average of the deviations shall be used.

b. This AFIS segment or checkpoint will be used as a reference for subsequent checks of course alignment and airborne monitor reference evaluation.

c. Following an antenna change, optimize the orbital alignment, then re-establish the reference.

d. During a periodic evaluation, if the alignment is found more than 1° from that previously established, perform an alignment orbit. If satisfactory, reestablish the reference radial value. Advise maintenance of mean orbital alignment shift beyond 1°.

e. Determine DME accuracy as described in paragraph 201.32041.

201.32011 Ground Checkpoint Method. After the checkpoint has been selected, measure it to the nearest tenth degree. Round out to the nearest degree the measured bearing from the antenna which overflies this checkpoint. This will establish a radial which can be selected in the omnibearing selector (OBS). Fly the aircraft along this radial (usually at 1,500' above the antenna), but deviate temporarily to fly directly over the reference checkpoint. Actuate the event mark directly over the checkpoint to obtain a recording that has an accurate check of course alignment. Determine the alignment error IAW paragraph 106.51.

201.32012 Theodolite Method.

a. Adjust the theodolite to sight along the bearing, which will coincide with the radial. Fly the aircraft along the radial at 1,500 ft above the antenna. The theodolite operator will advise the pilot when the aircraft is drifting right or left of the selected azimuth.

b. The theodolite operator shall actuate the event marker by means of 1,020 Hz tone or verbal mark when the aircraft is observed on the correct bearing. Determine the value of deflection of the crosspointer and compute the alignment error.

c. The following alternate method may be used. Fly the aircraft on-course with reference to the crosspointer, maintaining a constant altitude. The theodolite operator will track the airplane and mark the recording in the aircraft from the theodolite site. The bearing of the aircraft, as determined by the theodolite, shall be the actual measured magnetic azimuth. The alignment of the radial can then be computed from the recording.

201.3202 Monitor Reference Evaluation.

a. The monitor reference evaluation determines the minimum amount of azimuth course shift required to activate the ground facility monitor alarm system.

b. Monitor reference may be established either in the air or on the ground. Once established, the check shall become the reference for all subsequent checks. The procedure for establishing a monitor reference is as follows:

(1) With the course in the normal operating condition.

(2) With the course shifted to the monitor reference point.

(3) With the course shifted to the monitor reference point in the opposite direction from step (2) above.

(4) With the course returned to the normal operating condition.

NOTE: Step (4). There is no requirement that the course return to the measurement in Step (1). Monitor shifts of more than 1° will be brought to the attention of appropriate engineering personnel to determine if environmental or equipment related.

In each of these conditions, the course alignment will be compared by reference to recorded data to determine the amount of shift to the alarm point and to verify that it has returned to a normal condition.

c. Facilities that have dual parallel monitors require a monitor evaluation on one transmitter only. Facilities that have two individual monitors require evaluations on each transmitter.

201.3203 En Route Radials

a. FISSV. Radials flown to determine the facility's ability to support the FISSV shall be flown at a minimum altitude of 1,000 ft (2,000 ft in designated mountainous terrain) above the site elevation, or the highest terrain or obstruction, to a distance of 40 miles for “L” and “H” class facilities, or 25 miles for "T" class facilities. The 40-mile or 25-mile distances are considered the standard flight inspection coverage distances.

b. All radials supporting instrument flight procedures shall be checked for signal quality and accuracy. Fly Airways, Off-Airway Routes, or route segments throughout the length of the intended use, at or below the minimum requested altitudes. If these radials have procedural requirements beyond the Flight Inspection Standard Service Volume (FISSV) distance, they shall be inspected to the additional distances at the minimum requested altitudes.

c. Changeover Points. The minimum en route altitude (MEA) for an airway change-over point (COP) shall be the altitude where usable signals exist from the supporting stations. There is no requirement to check coverage beyond the COP.

d. Evaluate azimuth alignment, course sensitivity or modulations, polarization, roughness and scalloping, bends, identification, voice features, sensing, and signal strength while flying the desired azimuth.

201.32031 Intersection Radials/DME Fixes

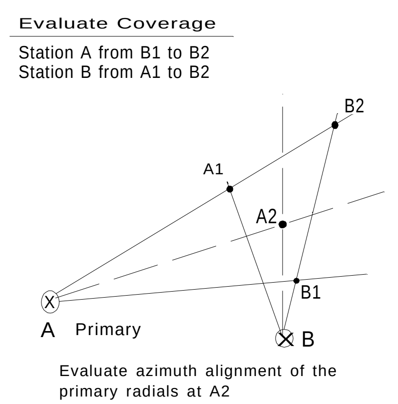
a. Intersections are used to identify azimuth positions in space. These intersections can be used for navigational fixes, reporting points, DME fixes, COPs, etc. Establish a minimum reception altitude (MRA) for each intersection that does not meet the minimum en route IFR altitude (MEA). The MRA is the lowest altitude where reliable signals can be received within the procedural design area.

b. Fixes located within the FISSV: When fixes are located within the FISSV (see definition in Section 301), coverage throughout the fix displacement area can be predicted (fix displacement evaluation is not required). Inspect these fixes for azimuth alignment, course sensitivity or modulations, identification, roughness and scalloping, and signal strength along the radial track used to define the fix at the proposed procedural use altitude.

c. Fixes located beyond the FISSV:

(1) If the fix is located beyond the FISSV of any facility that supports the fix, the appropriate fix displacement coverage evaluation shall be accomplished for that facility. When establishing a fix that is located beyond the FISSV, the station(s) are evaluated on the furthest side from the facility of the fix to ensure that usable signals exist. Evaluations shall include course sensitivity or modulations, identification, roughness and scalloping, alignment, and signal strength.

Figure 201-1



The radials of the primary facility are evaluated at ± 4 nm or ± 4.5°, whichever is greater. The crossing radial is evaluated at ± 3.6°.

NOTE: The primary facility provides primary course guidance to the intersection. If either facility can be the primary, then evaluate both at ± 4 nm or ± 4.5°. If the crossing facility is an NDB, the primary facility is evaluated ± 5° from the NDB on-course bearing. In Figure 201-1, if Station B were an NDB providing the crossing radial, A1 and B2 would be ± 5° from the NDB on-course bearing.

(2) Coverage Evaluation: The radials of the primary facility are evaluated at ± 4 nm or ± 4.5°, whichever is greater. At a distance of 50.8 nm, 4 nm equals 4.5° off course. When a fix is beyond 40 nm but within 50.8 nm of the primary facility, the degrees off course that equals 4 nm must be calculated. In Figure 201-2, XXX is the primary facility, and the fix is located 41 nm from the facility. A determination of the degrees off course that equals 4 nm at 41 nm can be made using the chart in Figure 303-7. For this example, the offset radials equal ±5.6° at 41 nm.

When the radials of the primary facility are beyond 50.8 nm, the offset radials will be ± 4.5°.

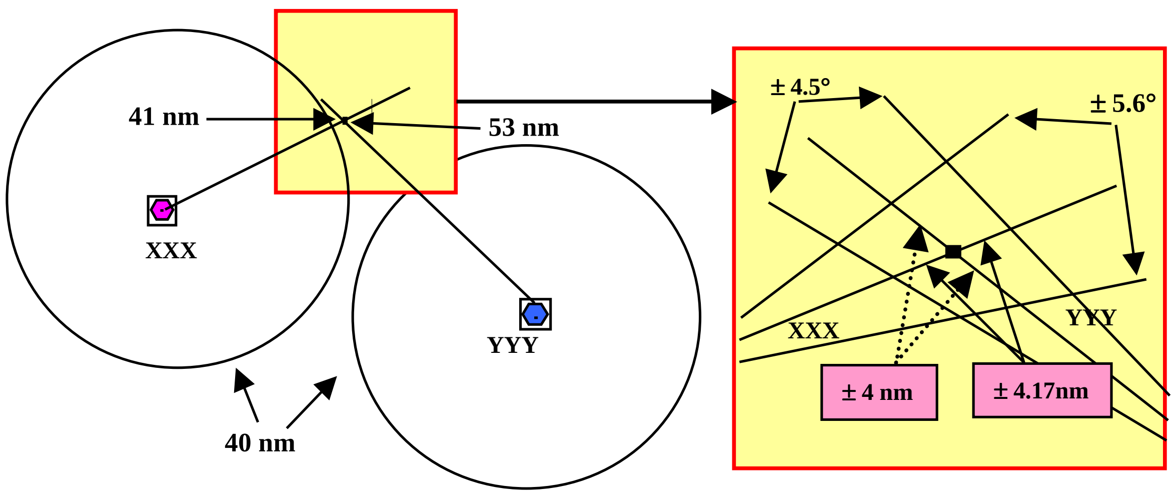
An alternative method may be used for the coverage evaluation. Beyond 40 nm but within 50.8 nm, you may fly an arc about the facility at a distance equal to the fix distance plus 4 nm or 4.5°, whichever is greater (3.6° for crossing radials). Using the chart in Figure 303-7, determine the degrees off course equal to 4 nm at the fix distance to determine the appropriate start and stop point of the arc. For the example in Figure 201-2, we will assume both facilities may be primary. Therefore, Facility XXX arc would be flown at 45.17 nm (41 nm plus 4.17 nm which is the distance that equates to 4.5° at 53 nm) from ± 5.6°. The arc about Facility YYY would be flown at 57 nm (53 nm plus 4 nm which is the greater of 4.5° or 4 nm at 41 nm).

For radials beyond 50.8 nm, the arc will remain ± 4.5°, but the distance that must be added to the fix distance arc will increase as the distance outbound increases (see Figure 303-7).

(3) Stand-Alone DME Fixes shall be evaluated for coverage ± 4 nm or 4.5^0 (whichever is greater) at 5 nm greater than the fix distance.

d. During a periodic evaluation, verify that the crossing radial identifying the fix supports the procedure. Verification may be by recording trace or analysis of the cockpit instrumentation. There is no requirement to evaluate the fix displacement area.

Figure 201-2



201.3204 Terminal Radials/Fixes (Approach, Missed Approach).

a. Evaluate all the radial segments that comprise the STAR, SID/DP, or SIAP on commissioning and frequency change inspections. All final segments shall be flown in the direction of intended use. Ensure the procedure is compatible with human factors (see Paragraph 214.43) and the navigational guidance is satisfactory. On commissioning and frequency change inspections, the radials shall be evaluated to include the holding patterns, procedure turns, approach and missed approach, or departure routings. During periodic, antenna change, MAGVAR change, and facility rotation inspections, evaluate only the final approach segment of the SIAP(s). Evaluate other terminal radials on a surveillance basis.

b. All evaluations shall be conducted at the procedural altitudes except the final approach segment. This segment is evaluated from the FAF (or final descent point) descending to 100 ft below the lowest MDA to the MAP. During site, commissioning, reconfiguration, antenna change, and changes to the applicable SIAP, evaluate VOR radials 5° on each side of the final approach radial. Evaluate the offset VOR radials on one transmitter at the same altitudes as the final approach radial segment.

c. When terminal fixes are located within the facility's FISSV or below the FISSV but within the standard service volume, coverage, throughout the fix displacement area, can be predicted (fix displacement evaluation is not required).

d. TACAN Azimuth Null Checks will be flown as follows:

(1) Approved Procedure

(a) On commissioning inspections, antenna change, new procedures, and changes in FAF altitude of 300 ft or more on existing procedures, the following null checks are required:

1 Approach radial

2 5° either side of the approach radial

The radials will be flown inbound or outbound, on a level flight, from 3 miles outside the final approach fix (FAF) to 3 miles inside the FAF at the lowest minimum altitude for FAF:

(b) Nulls, defined as any repeatable out-of-tolerance crosspointer action or condition of unlock usually accompanied by rapid changes in the automatic gain control (AGC) and oscilloscope indications of a loss or distortion of the 15 and 135 cycle modulation components, are not permitted in this area. If a null is found, measure the vertical angle by flight in the area described above at an altitude 500 ft above or below the minimum FAF altitude and inform maintenance so that the problem can be corrected if possible. If the null cannot be corrected by antenna change or height adjustment, a new procedure will be developed which will avoid the affected area. Null checks are required on only one transponder. Due to the effect of the station cone on azimuth performance, null checks are not required when the TACAN facility is located at the FAF.

e. Commissioning Inspections. On commissioning inspections, missed approach and SID/DP radials for facilities which are located within the airfield boundary shall be evaluated from overhead the station outbound to the limits depicted for the procedure. If no termination point is depicted, the radial shall be checked to where it joins the en route structure or the expected coverage limit of the facility category, i.e., 25 miles for a "T" class and 40 miles for "L" or "H" class facilities.

f. Evaluate the radials for signal quality and accuracy. The final approach course shall deliver the aircraft to the desired aiming point. Evaluate azimuth alignment, course sensitivity or modulations, polarization (when within 5 to 20 nm of the station), roughness and scalloping, bends, identification, and signal strength when flying the radials. Evaluate the 5° offset radials for course sensitivity or modulations, roughness and scalloping, spectrum analysis, identification, and signal strength.

g. Magnetic Variation Change Inspection. Evaluate one TACAN null and VOR offset radial 5° beyond the final approach radial, IAW Paragraphs 201.3204b and c, to ensure a minimum of 5° has been checked each side of the published final approach radial. For example, when the published approach radial is changed from R090 to R087, based on a MAGVAR change from 2° East to 5° East, fly R082 as the null/offset radial. R095 will have been flown previously to support the R090 approach, and provides the 5° minimum requirement. Ensure the published facility restriction, receiver checkpoint, and ESV radials, changed per the MAGVAR check, are reported on the flight inspection report.

201.32041 Distance Accuracy. Check the accuracy of the TACAN/DME distance information during inspection of the radials, orbits, approach procedures, and DME fixes. The exact mileage indication displayed on the distance indicators shall be noted on the recordings. Comparison of the scaled distance on the chart (converted to slant range) to the distance indicated by the TACAN/DME distance indicator at the various points may be made for accuracy determination.

a. It is not necessary to compute the slant range for distances measured at altitudes below a vertical angle of 5° because the relative difference between slant and chart range is negligible (less than 1/2 to 1 percent).

b. For ease of computation, a 5° angle is equivalent to approximately 1,000 ft above the antenna at 2 miles and 5,000 ft above the antenna at 10 miles. Above a 5° angle, a DME slant range mileage shall be converted to chart distance.

201.32042 Erroneous Distance Information. If the ground facility is emitting false reply pulses, erroneous distance information may be present. This condition usually occurs within 25 miles of the antenna. Whenever actual false lock-ons are experienced, the offending facility shall be removed from service until this condition is remedied.

201.3205 Orbit Evaluations. Orbit evaluations are used to determine azimuth error distribution and signal quality. Orbit data are used as reference information. Establish reference alignment during commissioning, antenna change, facility rotation, or on any inspection if no orbital reference exists in facility data. Evaluate for deviation from the reference during all subsequent orbital evaluations. When optimizing alignment, the mean orbital alignment should be within ± 0.5°, and the system differential between a collocated VOR and TACAN should not exceed 1°. For dual transmitter systems, use the primary transmitter as the reference. (See Paragraph 201.3201).

201.32051 Alignment Orbit

a. The alignment orbit is used to determine the accuracy and optimum error distribution of the azimuth. The evaluation is conducted for 360° of azimuth. An orbit radius of 5 nm and beyond may be used when using GPS hybrid or equivalent for updating and 10 nm and beyond when using distance measuring equipment updating. When using theodolite, the orbit radius shall be the maximum visual range for the theodolite operator. The orbit may be flown clockwise (CW) or counterclockwise (CCW), but once established, it shall be flown in the same direction, at the same distance and altitude, on each subsequent inspection. Compute a tapeline altitude to fly the orbit at a standard angle of 4 to 6° from the site. The objective of the check is to help facilities maintenance personnel determine environmental problems close in to the facility. The ratio between distance and altitude becomes critical when looking for low angle reflections or shadowing. Altitudes and distance may be modified when conditions prevent establishing them at the recommended 4 to 6° (air traffic requirements, engineering or maintenance support, and site conditions). Indicate deviations from the standard on the flight inspection report.

b. If alignment cannot be determined orbitally, it may be measured by flying one radial in each quadrant. The radial alignment shall be determined from no less than a 5 nm segment flown within the distance and angular parameters noted above. A partial orbit, augmented with radial alignment, is preferred over alignment determined solely by radial means. The use of radial flight in lieu of orbital alignment shall be approved by the Flight Inspection Technical Support Branch Manager.

c. One orbit may be flown on dual transmitter facilities during any inspection, except commissioning, by requesting transmitter changes. If sufficient transmitter changes cannot be accommodated (at least one in every 90°), fly an orbit on each transmitter.

d. During the orbit, evaluate azimuth alignment, course sensitivity or modulations, sensing and rotation, roughness and scalloping, identification, and signal strength (a minimum of 1 evaluation every 20°). Out-of-tolerance conditions found during an orbital inspection shall be confirmed by a radial evaluation before restricting a facility or issuing a NOTAM. The radial evaluations normally have priority.

e. Course error distribution must be determined prior to rotation (if required) to achieve optimum station balance. It is not necessary to refly the orbit after this facility rotation, provided the direction and magnitude of the adjustment can be confirmed radially. Apply the confirmed azimuth shift to the alignment orbit for final error spread determination and plotting. Complete the remaining facility rotation checklist items after the rotation.

f. Course Alignment. On periodics, if a change in mean course alignment of more than 1° is found, contact facilities maintenance. Facilities maintenance will conduct an evaluation to determine if the change in the facility was caused by a maintenance problem or caused by an environmental change.

201.320511 Ground Checkpoint Method. Checkpoints are desired every 20° of azimuth; however, acceptable results can be obtained with fewer checkpoints if a precise orbit track is maintained. Whenever possible, checkpoints should be selected that will occur near the crossover, in order to avoid error induced by possible non-linearity of the crosspointer. If it is necessary to change altitude during the orbit, discontinue the orbit at a checkpoint, then maneuver in that area while changing altitudes.

Cross the same checkpoint at the new altitude and mark the checkpoint on the recording. Minor changes in altitude may be made without interrupting the orbit. Ground checkpoints may be established and used at locations where map or chart accuracy is questionable by verifying accuracy with the theodolite. Many types of references may be used for checkpoints (see Paragraph 309.4). By establishing such ground checkpoints, the necessity for recurring theodolite use for periodic checks can be eliminated. Subsequent flight checks can be made using the appropriate chart marked with these ground checkpoints.

201.320512 Theodolite Method. Advise the theodolite operator of the bearing, vertical angle, altitude, range of the aircraft from the site, and when the aircraft is established on the orbit. After sighting the aircraft, the theodolite operator shall preset the theodolite to the nearest 5 or 10° increments ahead of the aircraft and, at the preselected reference point on which the aircraft (engine, nose, etc.) crosses the vertical crosshair, transmit the 1,020 Hz tone or verbal mark to the aircraft. Preset the theodolite to the next 5 or 10° azimuth increment and repeat the procedure. The theodolite operator shall broadcast the theodolite azimuth and angular elevation following each mark. Repeat this procedure throughout a complete orbit with an overlap of at least one transition. The combined receiver error and radial displacement at each 10° point where the course line crosses the center of the recording may be measured with 10-point dividers. Use the leading edges of the appropriate mark indication as a standard. Station error, corrected for receiver error and theodolite offset, may be determined and plotted.

201.32052 Coverage.

a. This check is conducted to determine the facility's ability to support the Flight Inspection Standard Service Volume (FISSV). The FISSV shall be established as follows: On "T" class facilities, the FISSV is 25 nm and 1,000 ft (2,000 ft in designated mountainous areas) above site elevation or **intervening terrain.** On "L" and "H" class facilities, the distance extends to 40 nm, and the altitudes are the same as for the "T" class. Establish facility restrictions and performance status based on the FISSV. One complete orbit (one transmitter only) shall be flown at either:

(1) The applicable FISSV

(2) Altitudes high enough to receive in-tolerance signals. If these altitudes are higher than the altitudes in paragraph (1) above, facility restrictions and NOTAM action are required.

b. During the orbit, evaluate azimuth alignment, course sensitivity or modulations, sensing and rotation, roughness and scalloping, identification, and signal strength (a minimum of 1 evaluation every 20°).

c. Out-of-tolerance conditions discovered during orbital inspections shall be confirmed by a radial inspection before restricting a facility or issuing a NOTAM. An orbit segment used to establish a restriction may be defined laterally by orbital means. Radials flown through the most severe out-of-tolerance area may be used to define the distance and altitude limits of the entire segment. The radial inspection results normally have priority over orbital inspection data. In areas of multiple restricted segments, it may be appropriate to group those segments into larger, easier to understand restrictions. The advantages of this possible over-restriction in some areas must be weighed against user requirements. An arc at the restricted altitude shall be flown through the restricted area at the coverage limit to determine adequate signal coverage.

d. Procedures flown below or outside the FISSV, which are found unsatisfactory, shall be denied, but a facility restriction is not required.

201.3206 Expanded Service Volumes (ESV's). An ESV is a volume of airspace, outside of a facility Standard Service Volume (SSV), that is approved for operational use by Spectrum Engineering, and where a facility meets the applicable flight inspection requirements. ESV's are required only when procedural use is predicated on a NAVAID's performance outside of the SSV, as illustrated in Section 303, Figures 303-5A – F.

When required, an ESV may be revalidated by orbital flight at the ESV distance and lowest approved altitude. Lateral limits of the area should encompass allowable radial misalignment or applicable fix displacement area. There is no need to inspect the upper limits of an ESV unless interference is reported or suspected.

In most applications, the VOR is the primary facility supporting procedural use (i.e., airways, fixes, intersections). When evaluating facilities supporting procedural uses, record all component signals. If any NAVAID component (i.e., VOR, TAC, or DME) does not meet flight inspection parameter tolerances, document the results as follows.

a. Within the applicable 25 or 40 nm flight inspection service volume, complete the appropriate flight inspection report form(s) and restrict the NAVAID accordingly.

b. Beyond the applicable flight inspection service volume but within the SSV, complete the appropriate flight inspection report form(s) and document flight inspection results on the procedures package forms. No facility restriction is required.

c. Beyond the applicable SSV, complete the appropriate flight inspection form(s), ESV forms, noting the component(s) which will not support the ESV, and document the results on the procedures package forms. No facility restriction is required.

For flight inspections beyond the applicable 25 or 40 nm distance, complete only the fields of the flight inspection report forms for the NAVAID components identified for procedural use.

201.3207 Receiver Checkpoints are established to allow pilots to check the accuracy of their receivers. Inability of a facility to support receiver checkpoints shall not result in facility restrictions.

201.32071 Ground Receiver Checkpoints will be established on the airport ramp or taxiways at points selected for easy access by aircraft, but where there will be no obstruction of other airport traffic. They normally will not be established at distances less than one-half mile from the facility, nor should they be established on non-paved areas.

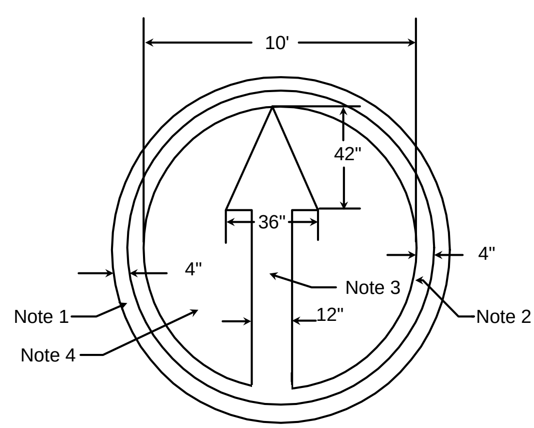
a. During the commissioning inspection, align the aircraft toward the station, with the aircraft receiving antenna over the selected point. Determine the correct facility radial and round off to the nearest whole degree. For VOR, position the aircraft receiving antenna alternately in three additional positions, 90° apart, and check for alignment stability. This radial will be published as the ground receiver checkpoint azimuth. Periodic flight inspections will be evaluated, with the aircraft aligned toward the station, and the receiving antenna over the checkpoint.

b. All azimuth bearings shall be stable and within prescribed azimuth tolerance. Evaluate azimuth alignment, course sensitivity or modulations, roughness and scalloping, identification, and signal strength. If a stable signal and alignment cannot be obtained at a location, select another site or establish an airborne receiver checkpoint.

c. The ground receiver checkpoint signs and airport surface markings shall be provided as described below. These signs shall be observed for continued maintenance during subsequent inspections of the facility. Slight variances in airport surface markings may be observed, which should not affect their acceptability, unless, in the judgment of the flight inspector, it could affect the usability of the checkpoint.

(1) Airport Surface Markings. The spot selected for the checkpoint shall be marked by a painted circle 10 ft in diameter as illustrated below.

Figure 201-3



NOTES:

1. White (may be bordered on inside and outside with 6-inch blackband, if necessary, for contrast).

2. Yellow (chrome yellow-taxiway aviation yellow).

3. Yellow. Arrow to be aligned toward the facility and extend the full width of the inner edge of the circle.

4. Interior of circle black (concrete surfaces only)

(2) Signs. The receiver checkpoint signs shall show the facility identification, channel, course selected (published) for the check, and the plotted distance from the antenna.

Example:

DCA-VORTAC
116.3 (CH 110) 147/327
DME 1.5 nm

The signs shall be distinct, easy to read, and shall not constitute a hazard to the operation of taxiing, landing, or departing aircraft.

For VORTAC's, if either portion does not support the checkpoint, annotate the Facility Data Sheet and notify Airfield Management to remove that portion from the sign.

201.32072 Airborne Receiver Check-points shall be designated over prominent ground checkpoints at specific altitudes. It is preferred that such checkpoints be near an airport so they are easily accessible to users. However, consideration should be given to selecting an area and altitude which will not interfere with normal traffic patterns.

a. The altitude specified for the receiver checkpoint shall be at least 1,000 ft AGL. The checkpoint should not be established at a distance less than 5 miles or more than 30 miles from the facility.

b. Fly the aircraft directly over the selected checkpoint either toward or away from the facility and mark the recording at the checkpoint. Compare the electronic radial recorded with the plotted geographic azimuth.

c. The electronic radial overlying the geographic checkpoint, rounded off to the nearest whole degree, will be the azimuth published as the receiver checkpoint.

d. The actual distance from the airborne receiver checkpoint to the antenna, as determined from a map study, shall be checked against the distance indication received when directly over the checkpoint.

201.3208 Standby Transmitters. Both transmitters (when installed) shall be evaluated for each required checklist item except the coverage orbit, which is required on one transmitter only. Alignment evaluations may be made by changing transmitters during an evaluation and comparing the azimuth course shift. Transmitter changes shall not be made inside the final approach fix; however, transmitter changes made before the final approach fix are satisfactory for evaluation purposes. If comparison results are questionable, fly the final approach segment on each transmitter.

201.3209 Standby Power

a. The following checklist items will be inspected while operating on standby power:

(1) Course alignment (one radial)

(2) Course structure

(3) Identification

(4) Distance accuracy

b. The inspections are to be performed when flying a portion of a radial with the station operating on normal power and then repeating the check over the same ground track with the station operating on standby power.

201.3210 Associated Facilities

a. Inspect associated facilities concurrently with the inspection of the primary facility. These include marker beacons, lighting aids, communications, etc., which support the en route/approach procedures and landing weather minimums of an associated approach procedure.

b. Conduct inspections of these facilities in conformance with the detailed procedures and tolerances contained in the applicable section of this manual.

201.3211 Crossing Radials on Precision Approaches

a. When a RHO-THETA crossing radial is used to determine an IAF, FAF, etc., on a precision approach, an evaluation is conducted while the aircraft is on-course, using the precision facility for guidance.

b. The initial check of the crossing radial shall be verified by recording trace analysis for azimuth alignment, course sensitivity or modulations, identification, roughness and scalloping, and signal strength. If the fix is not contained within the FISSV of either facility, an ESV must be established to support the procedure.

c. During a periodic evaluation, verification may be by recording trace or analysis of the cockpit instrumentation.

201.4 ANALYSIS.

201.41 Identification (ID). This check is made to ensure the identification is correct and is usable throughout the operational service volume.

a. Approved Procedure. Evaluate the identification during all checks. The facility shall be restricted if the identification is not usable in all areas of required coverage.

b. Identification Sequence

(1) VOR's, VOR/DME's, and VORTAC's with VOR voice identification using dual voice code reproducers at dual location or single voice code reproducer at single VOR location uses the following sequence:

Identification on VOR in code.

Identification on VOR by voice

Identification on VOR in code.

Identification on TACAN/DME at the normal time for voice identification on the VOR.

(2) VOR's, VOR/DME's, and VORTAC's with VOR voice identification using single voice code reproducer with dual VOR equipment: The identification sequence is the same as in paragraph (1) above; however, synchronization will not exist between the TACAN and VOR identification. Voice identification may be heard with the keyed ident, and the flight inspector must determine from an operational standpoint if the identification is clear and that the course is not adversely affected.

(3) VOR's, VOR/DME's, and VORTAC's without VOR voice identification uses the following sequence:

Identification on VOR in code.

Blank

Identification on VOR in code.

Identification on TACAN/DME at the normal time for code identification on the VOR.

c. Identification is a series of coded dots and dashes and/or voice identification transmissions that amplitude modulate the VOR RF carrier frequency. The ID enables a user to identify the VOR station.

d. Evaluate the ID signals for correctness, clarity, and to ensure there is no adverse effect on the azimuth course structure. When it is difficult to determine what effect the ID has on the azimuth course structure because of roughness and scalloping, evaluate the same azimuth radial with the ID off and compare the results. When simultaneous voice and Morse coded ID are installed, the modulation levels are adjusted so both audio levels sound the same. These levels are approximately 30 and 8 percent, respectively. When a voice broadcast feature is installed (ATIS, AWOS, etc.), the voice ID feature is suppressed during voice transmissions, but the Morse coded ID should still be heard. The Morse coded ID signals must be identifiable throughout the entire unrestricted VOR coverage area, including ESVs. When the identification is unacceptable, take appropriate NOTAM action and notify facility maintenance.

e. For facilities with standby transmitters and separate standby ID equipment, use the Morse coded ID to identify each transmitter. The number one transmitter has equal spacing between all characters of the coded identification. The spacing between the second and third characters of the number two transmitter is increased by one dot.

201.42 Voice.

a. The voice broadcast feature, when installed, allows a user to receive radio communications, weather and altimeter information, air traffic and airport advisories, etc., on the VOR frequency. Voice amplitude modulates the VOR carrier frequency by 30 percent.

b. Inspect the voice for clarity to ensure there is no adverse effect on the azimuth course. Ensure that all published remote sites can respond on the VOR frequency when contacted. Maintain a periodic surveillance of the quality and coverage of the voice transmissions throughout the VOR coverage area.

c. Advisory services that provide voice broadcast features include ATIS, AWOS, ASOS, TWEB and HIWAS. Some services may not be continuously available. Inspect only the services available.

d. When the voice transmissions are unsatisfactory, but the remainder of the VOR operation is satisfactory, NOTAM only the voice feature out-of-service. When the voice modulation adversely affects the VOR operations, the voice portion must be disabled and NOTAMed out-of-service or the VOR shall be NOTAMed out-of-service.

201.43 Sensing and Rotation.

a. The sensing and the following rotation check are required at the beginning of the flight inspection. The position of the aircraft on a radial from the station must be known. Select the azimuth of the radial being flown. When the crosspointer is centered, the "TO-FROM" indicator will properly indicate "FROM" if sensing is correct. For AFIS-equipped aircraft, compare the computer-generated bearing. Sensing should be checked before rotation, as incorrect sensing may in itself cause the station rotation to appear reversed. See graphics in Section 303.

b. Rotation. Upon completion of the sensing check, conduct a partial counterclockwise orbit. The radial bearings shall continually decrease.

201.44 Modulation Levels.

a. Modulation Levels. The three individual modulation levels associated with the VOR are: 30 Hz AM, the 30 Hz FM (or deviation ratio of the 9960 Hz subcarrier) and the 9960 Hz AM modulation of the VOR RF carrier.

(1) 30 Hz AM is optimized at 30 percent and is termed the "variable phase" on conventional VORs.

(2) 30 Hz FM (a deviation ratio of 16 is equivalent to 30 percent modulation value) is termed the "reference phase" on a conventional VOR. On Doppler VORs, it is termed the "variable phase."

(3) 9960 Hz AM is optimized at 30 percent. The 9960 Hz amplitude modulation of the VOR RF carrier may cause receiver flag warnings when out-of-tolerance.

Modulation values shall meet operational tolerances throughout the unrestricted service volume of a VOR. Determine the average modulation values or the graphical average of the recorded modulation values (when available) when fluctuations are encountered.

b. Analysis. Adjustments of modulation values may be made on any radial (within 10 to 25 miles of the facility).

201.45 Polarization.

a. Polarization causes azimuth course variations whenever the aircraft is banked around its longitudinal axis. It is caused by the radiation of a vertically polarized signal from the VOR antennas (horizontal polarization on TACAN) or other reflective surfaces around the site. The indications are similar to course roughness and scalloping, but normally can be separated by relating the course deviations to the aircraft banking. When roughness and scalloping cannot be separated from polarization, select another radial. The evaluations should be conducted on another nearby radial in the same azimuth quadrant.

b. Evaluation. Polarization should be evaluated any time a radial is checked and within 5 to 20 miles (inbound or outbound) from the facility. Only one radial required on TACAN. The preferred method of evaluating for polarization is to bank the aircraft 30 degrees around the longitudinal axis (starting on either side) returning to level flight momentarily, bank 30° in the opposite direction and returning to straight and level flight. During the aircraft banking, the tracking and heading changes must be kept to a minimum. The course deviations that occur during the 30° rolls may indicate polarization.

The indications of polarization may be influenced by course roughness and scalloping. A confirmation check is required if out-of-tolerance conditions are discovered using this method.

c. Confirmation Procedure. Fly over a prominent ground checkpoint, located 5 - 20 miles from the facility. Execute a 30° bank and turn, and hold this attitude through 360°. End this maneuver as close to the same ground checkpoint as possible. Mark the recording at the beginning and end and at each 90° change in azimuth heading. If polarization is not present, the course will indicate a smooth departure from and return to the "on-course" position, deviating only by the amount that the aircraft is displaced from the original azimuth.

201.46 Spectrum Analysis.

a. The RF electromagnetic spectrum from 108 to 118 MHz is reserved for VOR and ILS localizer signals. Undesirable RF signals can be radiated in this frequency band that interfere with the VOR signals. Electromagnetic interference (EMI) signals can be produced by electrical manufacturing processes, power generating facilities, etc., which may be sporadic. Radio frequency interference (RFI) may be caused by other VORs, harmonics of other frequencies, FM stations, etc. which are usually continuous.

b. The VOR spectrum shall be monitored for undesirable electromagnetic radiation when RF interference is suspected. When interfering radiation is observed, it is not justification for restricting the facility unless other flight inspection tolerances are exceeded. Undesirable signals shall be reported to facilities maintenance.

c. Facility restrictions and NOTAM's, established by spectrum management, shall be identified on the facility data sheet. These restrictions shall not be removed by flight inspection alone.

201.4601 TACAN Analysis. The oscilloscope, TACAN Test Set, or AFIS (display / plots) should be used for analysis of TACAN signals. The following are suggested analytical procedures, and no facility restrictions are to be applied if adjustment cannot be made or if maintenance personnel are not available for adjustment. The composite video, when displayed on the oscilloscope, will yield considerable data about the TACAN facility. The following video parameters may be measured:

(1) 15 Hz modulation

(2) 135 Hz modulation

(3) Identification train

(4) Reflections

(5) MRG size

(6) Auxiliary Reference Group (ARG) size

(7) ARG count

201.4602 Modulation Percentage 135 and 15 Hz. Measure the modulation of each component and calculate the percentage (see Section 302). Notify maintenance if modulation limits are exceeded.

a. Modulation measurements are more easily and accurately made via the TACAN Test Set or AFIS. The oscilloscope should be used only when other options are not available.

b. Identification Train. To measure the ident spacing group, adjust the oscilloscope so that the main burst is on the left edge of the graticule and the first auxiliary burst is on the right edge. When the ident is on, the reference bursts and the ident groups become very evenly spaced, and a group should appear on each division line.

c. Reflections. Reflected signals may be detected by examining the composite video. Reflections, when present, may duplicate the normal pattern in an image pattern slightly displaced to the right. Reflections may be of sufficient amplitude to cause the pattern amplitude to oscillate or cause the modulation percentage to oscillate at a sine wave frequency dependent on velocity and position of the aircraft.

d. Main Reference Group Size. Size refers to the number of pulse pairs in a group. For "X" channel, there should be 12 pulse pairs in the main reference group spaced 30 usec apart with spacing of each pulse in a pair of 12 usec. For "Y" channel, there are 13 single pulses in the MRG spaced 30 usec apart. If the TACAN test set indicates a discrepancy in the group size, use of the oscilloscope will identify the trouble. Advising maintenance of the condition found will greatly ease their task of correcting the problem.

e. Auxiliary Reference Group Size. Size refers to the number of pulse pairs in an auxiliary reference group. For "X" channel, there should be six pulse pairs spaced 24 usec apart with spacing of each pulse in a pair of 12 usec. For "Y" channel, there are 13 single pulses in a group spaced 15 usec apart. If the TACAN test set indicates a discrepancy in the group size, use of the oscilloscope will identify the trouble. Advising maintenance of the condition will ease their task of correcting the problem.

f. Auxiliary Reference Group Count. Count refers to the number of auxiliary reference groups between North reference bursts or groups. There are eight auxiliary reference groups between North reference bursts. If the TACAN test set shows the loss of auxiliary reference groups, use of the oscilloscope will quickly identify the exact problem. Advising maintenance of the condition will greatly ease their task of correcting the problem.

g. Operational Limits. Measurements should fall within the following limits:

Parameters	Limit	Remarks
15 Hz Modulation	10 – 30%	RANTEC Antennas vary 17 – 23%
135 Hz Modulation	10 – 30%	RANTEC Antennas vary 11 – 26%
Identification pulse spacing	740 microseconds	Synchronized with burst.
Reflections	N/A	No derogation of facility performance.
MRG size	12 ± 1 pulse pair	
ARG size	6 ± 1 pulse pair	
ARG count	8 ± 0 burst	

201.47 Course Structure

a. Roughness, scalloping, and bends are displayed on the recorder charts as deviations of the crosspointer (course deviation indicator) recording trace. Roughness will show a series of ragged irregular deviations; scalloping as a series of smooth rhythmic deviations; and the frequency of each is such that it is not flyable and must be "averaged out" to obtain a course.

b. To measure the amplitude of roughness and scalloping, or the combination, draw two lines on the recording which are tangential to and along each positive and negative peak of the course deviation. The number of degrees or microamperes between these lines will be the total magnitude of course deviations; one-half of this magnitude will be the plus and minus deviations.

c. The third line is drawn equidistant from these lines to obtain the average "on course" from which course alignment is measured. Thus, the instantaneous alignment error of the course may be computed from the course recordings at any point where an accurate checkpoint has been marked on the recording. Alignment error will be referred to in degrees to the nearest tenth. Misalignment in a clockwise direction is considered positive. Where the magnetic azimuth of the measured (ground) checkpoint is greater than the electronic radial, the error is positive. (See Figure 201-6.)

d. A bend is similar to scalloping except its frequency is such that an aircraft can be maneuvered throughout a bend to maintain a centered crosspointer. Accordingly, a bend might be described as a brief misalignment of the course. Bends are sometimes difficult to discern, especially in those areas where good ground checkpoints or other means of aircraft positioning are not available. It is, therefore, important to the analysis of a bend to consider aircraft heading and radial alignment deviations. A smooth deviation of the course over a distance of 2 miles would manifest itself as a bend for a flight inspection aircraft at a ground speed of 150 knots. An aircraft of greater speed would not detect such smooth deviations of the course as a bend unless it were over a greater distance. In the analysis of bends, further consideration should be given to the flight levels and speeds of potential users. Since speed, altitude, system response, and other factors are important in the analysis of course structure, the flight inspector should carefully evaluate the flyability factor before assigning a final facility classification.

201.4701 Application of Tolerances.

a. The alignment of a radial is the long-term average of the data points derived by eliminating the short-term variations of roughness and scalloping and bends. The measured alignment is influenced by bends and the length of the measurement distance. A short measurement segment may sample only an area that is really a bend when compared to a longer measurement segment. Flight inspectors must consider the procedural needs of the radial and measure enough of the radial to define alignment in the procedural use area. Thus, a short radial segment used for an approach may be unsatisfactory due to a bend being correctly analyzed as alignment when an identical bend would be correctly analyzed as a bend from the overall alignment of a longer airway radial segment.

b. The displacement of the course by a bend must not exceed 3.5° from either the correct magnetic azimuth or the average "on course" provided by the facility. The following two examples are offered for clarification:

(1) A radial having zero alignment error. The maximum bend tolerance of 3.5° is allowable both sides of the "on course", whether the bends occur singly or in a series.

(2) A radial having an alignment error of +2.0°. Further displacement of the course by a bend of +1.5° is allowable: this results in a +3.5° displacement from the correct magnetic azimuth. Displacement of the course of –3.5° from the average "on course" is allowable; this results in a –1.5° displacement from the correct magnetic azimuth.

c. In the event of roughness or scalloping, or combination, superimposed on the bend, the average "on course" shall be determined by averaging the total amplitude of such aberrations. This can result in a momentary displacement of the course of 6.5° where ± 3.0° of roughness is superimposed on a bend of 3.5°.

d. The criteria for roughness and scalloping shall not be applied strictly as a plus and a minus factor from the average course. Where it is apparent that a rapid deviation occurs only on one side of the course rather than in a series, the criteria shall be applied as a plus or minus factor.

201.48 Signal Strength. During all flight inspection evaluations, the received signal shall be equal to or greater than the specified tolerance.

201.49 DME Coverage shall be recorded or annotated and evaluated to the same coverage requirements as the service (ILS/VOR/NDB, etc.) it supports.

Figure 201-4
BENDS
(Example – not drawn to scale)

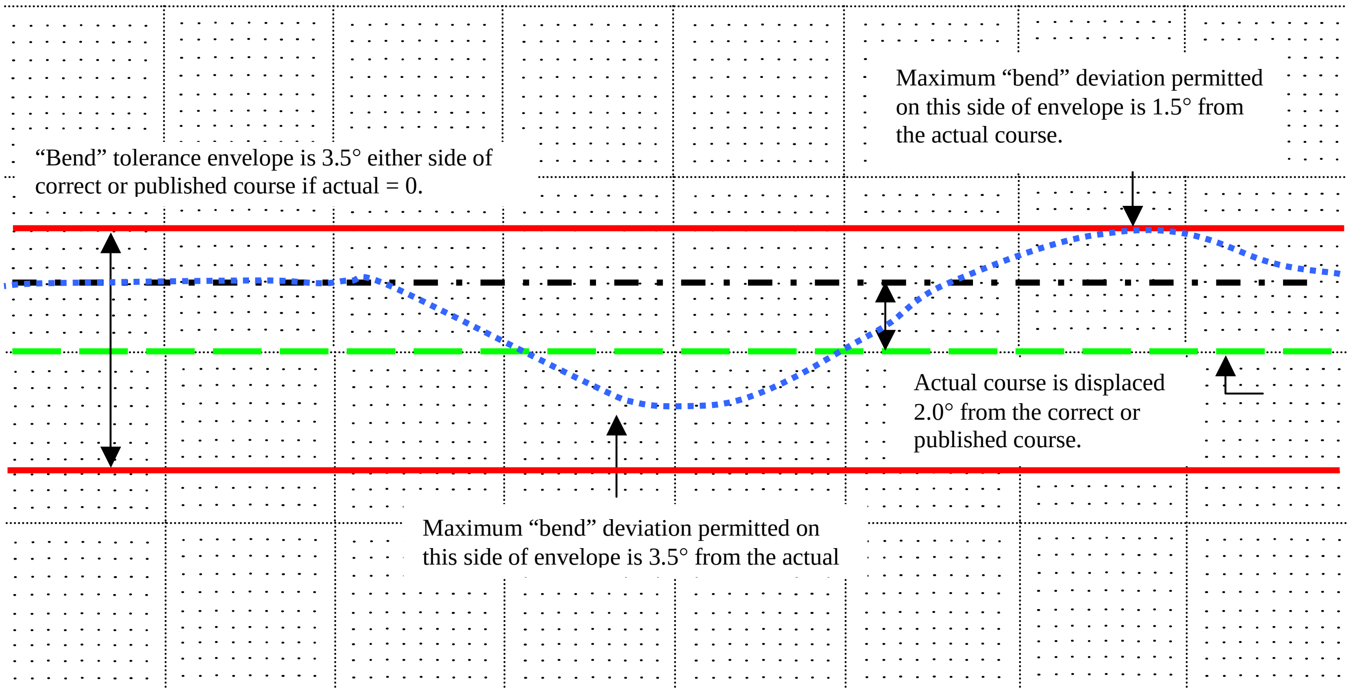
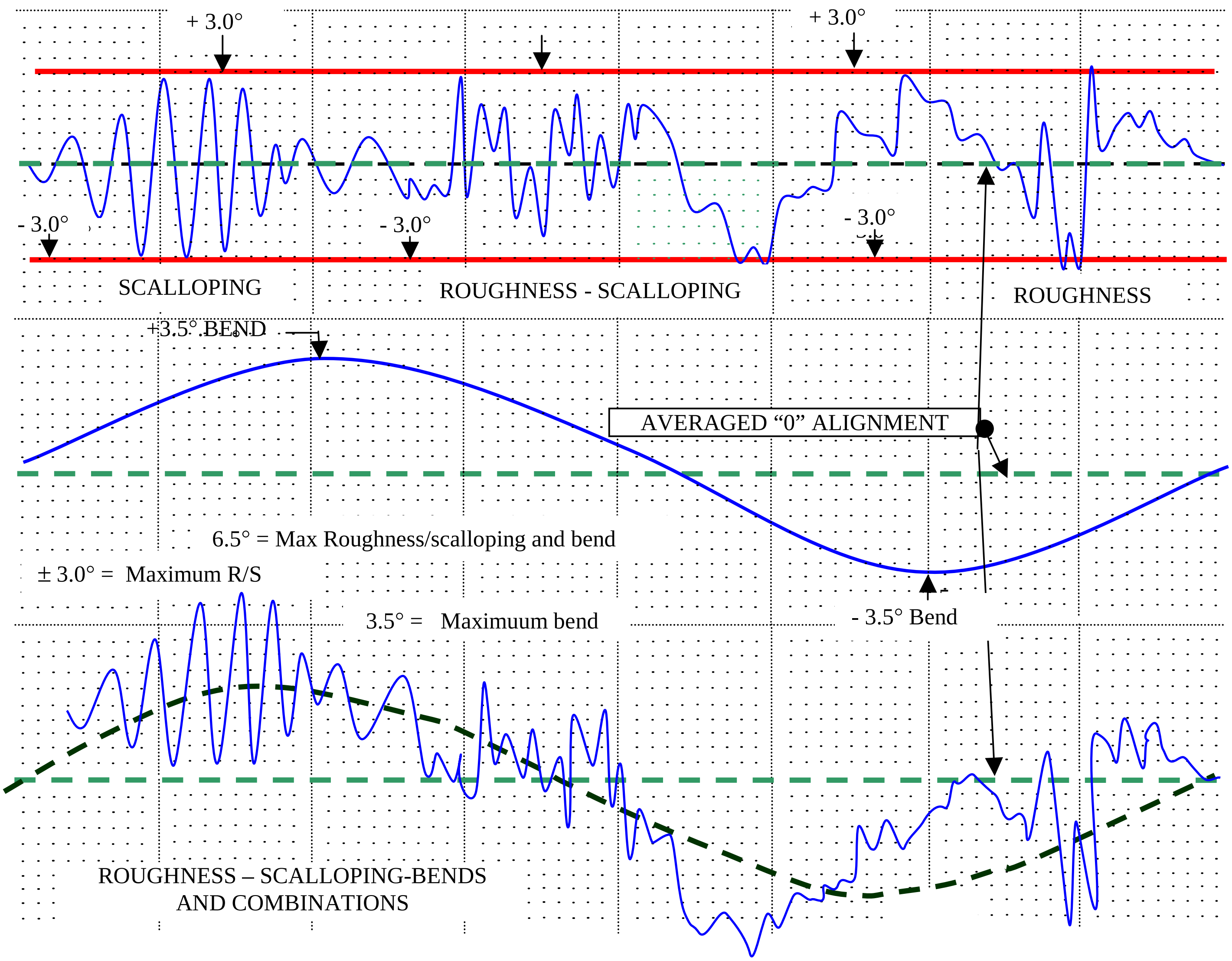


Figure 201-5

STRUCTURE

(Example – not drawn to scale)



201.5 TOLERANCES. Facilities that meet tolerances throughout the flight inspection SSV are classified as UNRESTRICTED. Facilities that do not meet tolerances in the flight inspection SSV are classified as RESTRICTED. Appropriate NOTAM action shall be taken to notify the user of the unusable areas (see Section 107). Facilities which do not meet tolerances beyond the flight inspection SSV shall not be restricted; however, procedural use shall be denied.

201.51 VOR TOLERANCES

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Identification	201.41	X	X	Morse code and voice identification shall be correct, clear and identifiable. The audio levels of code and voice shall sound similar. The course structure shall not be affected by the identification.

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Voice	201.42	X	X	Voice transmissions shall be clear and understandable. Simultaneous voice transmissions and code identification shall sound similar. The voice identification shall be suppressed during voice transmissions. Voice transmissions shall not cause more than ± 0.5° of course deviations.
Sensing and Rotation	201.43	X	X	The "To/From" sensing shall be "From" when positioned on a selected radial, and the bearings shall decrease in a counterclockwise direction around the station.
Modulation	201.44	X	X	
30 Hz AM				25 – 35% (optimum 30%)
30 Hz FM				Deviation Ratio 14.8 – 17.2 (optimum 16.0)
9960 Hz				20 to 35% on transmitters with voice modulation 20 to 55% on transmitters without voice modulation NOTE: Modulation exceeding these limits is acceptable, using the following criteria: .05 nm in any 1.0 nm segment from FAF to the MAP. 0.25 nm in any 5 nm segment from sea level up to 10,000 ft MSL. 0.5 nm in any 10 nm segment from 10,001 to 20,000 ft MSL. 1.0 nm in any 20 nm segment above 20,000 ft MSL.
Polarization	201.45	X	X	Less than or equal to 2.0°
Radials	201.47	X	X	
Alignment				Alignment of all electronic radials shall not exceed ± 2.5° of correct magnetic azimuth except: Deviations of the course due to bends shall not exceed 3.5° from the correct magnetic azimuth and shall not exceed 3.5° from the average electronic radial alignment. Roughness/Scalloping/Course Abberations: Deviations from the course, greater than 3.0° are acceptable, provided the aggregate does not exceed the following:

Structure				.05 nm in any 1.0 nm segment from FAF to the MAP. 0.25 nm in any 5 nm segment from sea level up to 10,000 ft MSL. 0.5 nm in any 10 nm segment from 10,001 to 20,000 ft MSL. 1.0 nm in any 20 nm segment above 20,000 ft MSL. Flyability: The effects of any one, or combination of any alignment and/or structure criteria, even though individually in tolerance, shall not render the radial unusable or unsafe.
Signal Strength	201.48	X	X	Received RF signal strength shall equal or exceed 5 µv or –93 dbm.
Receiver Checkpoints	201.32	X	X	Airborne Receiver Checkpoints. All parameters shall meet tolerances, and the alignment shall be within ± 1.5° of the published azimuth. Ground receiver checkpoints shall equal or exceed 15 µv or –83 dbm. Ground Receiver Checkpoints. All parameters shall meet tolerances, and the alignment shall be within ± 2.0° of the published azimuth. Inability of the facility to provide a ground or airborne receiver checkpoint according to the tolerances specified above shall not cause a restriction to be placed on the facility.
Monitor	201.32			The transmitter azimuth monitor reference shall not exceed ± 1.0°.
Standby Equipment	201.32 106.42	X	X	The standby transmitter shall meet all tolerances and the difference in azimuth alignment between transmitters shall not exceed 2.0°.
Standby Power	201.32 106.43	X		Operation on standby power shall not cause any parameters to exceed tolerances.
Orbital Alignment	201.3205		X	Notify maintenance if found to exceed ± 1° from the reference.

201.52 TACAN/DME Tolerances

Parameter	Reference Paragraph	Inspection C	Inspection P	Tolerance/Limit
Identification	201.41	X	X	Code identification shall be correct, clear, distinct, without background noise, and not affect course characteristics throughout the coverage limits of the facility. TACAN/DME identification shall be correctly sequenced with the VOR identification when collocated.
Sensing and Rotation	201.43	X	X	Sensing and rotation shall be correct.
Distance Accuracy	201.32	X	X	0.20 nm.
Polarization	201.45	X	X	Maximum ± 2.0° course deviation caused by horizontal polarization
Radials	201.47	X	X	
Alignment				Alignment of all approach radials shall not exceed ± 2.0° of the correct magnetic azimuth. Alignment of all electronic radials shall not exceed ± 2.5° of correct magnetic azimuth except: Deviations of the course due to bends shall not exceed 3.5° from the correct magnetic azimuth and shall not exceed 3.5° from the average electronic radial alignment.
Structure				Roughness/Scalloping/Course Abberations: Deviations from the course, greater than 3.0° are acceptable, provided the aggregate area does not exceed the following: 0.05 nm in any 1.0 nm segment from the FAF to the MAP. 0.25 nm in any 5 nm segment from sea level up to 10,000 ft MSL. 0.5 nm in any 10 nm segment from 10,001 to 20,000 ft MSL. 1.0 nm in any 20 nm segment above 20,000 ft MSL. Flyability: The effects of any one, or combination of any alignment and/or structure criteria, even though individually in tolerance, shall not render the radial unusable or unsafe.

				Unlocks: Approach Radials: No condition of azimuth or distance unlock is permitted within the final segment. The only exception would be normal passage through the station cone. En route criteria should be applied to all other segments.
				En route Radials: No more than one condition of azimuth unlock not to exceed 1 nm in a 5 nm segment and/or condition of distance unlock not to exceed 0.5 nm in a 5 nm segment.
				Note: Where airspace procedures depict a 10 DME or greater arc from the station to a final approach radial, en route tolerances shall be applied to both azimuth and range functions, except that no conditions of unlock are permitted 5.0° either side of any radial depicted or proposed for procedural use (i.e., initial approach fix, intermediate approach fix, final approach radial, lead radial, crossing radial, reference, point, etc.)
Signal Strength	201.48	X	X	The expected minimum signal strength is –80 dbm. However, a lesser signal shall not be the sole determination for restricting or removing a facility from service if a solid stable DME or azimuth lock-on is present.
Receiver Checkpoints	201.32	X	X	Receiver Checkpoint alignment shall not exceed ± 1.5° of the published azimuth. Distance shall be within 0.2 nm of the measured distance.
Monitor	201.32			The transmitter azimuth monitor reference shall not exceed ± 1.0°.
Standby Equipment	201.32 106.42	X	X	Operative standby and primary equipment will meet the same tolerances. The difference in the alignment of the course formed by each transmitter shall not exceed ± 1.5°. Distance differential between transmitters shall not exceed 0.2 nm.
Standby Power	201.32 106.43	X		Tolerances for a facility on standby power shall be the same as those on primary power.
Orbital Alignment	201.3205		X	Notify maintenance if found to exceed ± 1° from the reference.

201.53 SHIPBOARD TACAN

a. Introduction. Flight inspection of shipboard TACAN shall be performed when requested by the U.S. Navy. Due to the deployment of ships, these inspections shall be considered a one-time inspection and shall include all checklist items in paragraph 201.5301.

b. The flight inspection shall be scheduled upon receipt of the following information:

(1) Date and time of requested inspection.

(2) Name and hull number of the ship.

(3) TACAN channel.

(4) UHF primary and secondary communication frequency.

(5) Location of ships (latitude and longitude).

(6) Name and phone number (FTS and/or AUTOVON) of area coordinator.

c. The inspection shall be conducted with the ship underway and at a distance from shore that is sufficient to preclude interference or shielding of the signal by land mass during radial and orbital inspections.

d. The ship's radar shall be used as a basis to determine alignment. Fire control radar is considered the most accurate and will be used when available. Search (CIC) radar may be used if fire control radar is not available. Fire control information is given as TRUE bearings, and search radar is MAGNETIC.

e. Due to various antenna mount positions on ships and possible shielding by other antennas, masts, etc., nulls, and/or unusable sectors may occur. Suspected out-of-tolerance conditions shall be confirmed by a second evaluation of the area in question. Any sector of the TACAN that does not provide azimuth or distance information shall be reported immediately to the ship and documented in the flight inspection report.

201.5301 CHECKLIST. The following shall be inspected during shipboard inspections.

a. Identification.

b. Sensing and rotation.

c. Polarization.

d. Radial alignment (minimum of one).

e. Coverage.

f. Distance accuracy.

g. Frequency interference.

h. Alignment orbit.

i. Approach radial.

j. Standby equipment.

k. Stabilization.

l. Checks will be completed in accordance with appropriate paragraphs of this section unless modified or changed by the following:

(1) Those items normally inspected during radial flight may be accomplished on a radial to or from the ship or during inspection of the approach radial.

(2) Identification. Shipboard TACAN identification consists of two Morse code letters transmitted every 30 or 37 1/2 seconds.

(3) Coverage. Check a minimum of one radial for coverage to 40 nm during inbound or outbound flight at 700 MSL. Advise the ship if coverage is less than 40 nm.

(4) Frequency Interference. All of the ship's electronic equipment that is normally operating should be activated during the inspection.

(5) Alignment Orbit. The orbit shall be flown beyond 7 nm from the ships and no lower than 700 ft MSL. On those ships using search radar (CIC) for alignment, the orbit shall be flown below 2,000 ft MSL.

(6) Approach Radial The ship's approach radial is that radial that will guide the aircraft to the stern of the ship and will vary depending on the heading of the ship. Fly the radial from a minimum of 7 nm and 700 ft MSL to pass over the ship at 300 ft MSL. Determine and report radial alignment and structure.

(7) Standby Equipment. CV, LPH, LHA, and LPD ships have dual TACAN equipment. Spot check the standby equipment during radial flight by requesting a change from primary to standby equipment.

(8) Equipment Stability. Stability of the TACAN equipment may be effected during a turn of the ship. Stability will be checked during radial inspections by requesting the ship to turn left 15 degrees and then right 15 degrees. Advise the ship's personnel of any change to azimuth or alignment during the turns.

(9) Demand Mode. RESERVED.

201.5302 TOLERANCE. The tolerance contained in paragraph 201.52 will apply as appropriate to the shipboard TACAN.

SECTION 202. VOR TEST FACILITY (VOT)

SECTION 202. VOR TEST FACILITY (VOT)

202.1 Introduction. This section describes the procedure and tolerances used to inspect and certify a VOT. A VOT is a facility which transmits a test signal that is used to determine the operational status of a VOR receiver. A "Standard VOT" is a facility intended for use on the ground. It should be checked on the ground in the area of intended use. An "Area VOT" is a facility designed for use on the ground or in the air. It may be located to provide the test signal to one or more airports. Certification of an area VOT shall be based on checks of facility performance in all areas of intended use.

202.2 Preflight Requirements. At this time VOT's do not have a specified service volume. VOT service is identified and controlled by the FAA regional office having jurisdiction of the airport where VOT service can be provided. Area VOT's are strategically installed to serve certain specific airports on the ground. Additional airports may be identified by the appropriate regional office to receive airborne VOT service. The inspector shall inspect those airports identified to receive ground and/or airborne service. If, as a result of the inspection, adequate VOT coverage is found at additional airports, the FAA regional Office shall be notified. If they concur that the additional airports should receive VOT service, then the inspector shall publish the additional airports.

202.21 Facilities Maintenance Personnel. Prepare for flight inspection in accordance with paragraph 106.21.

202.22 Flight Personnel. Prepare for flight inspection in accordance with paragraph 106.22. The flight inspector shall also:

a. Research the possibility of replacing hard-to-get-at or time-consuming VOR ground checkpoints with area VOT service.

b. Determine if VOT service can be provided by present standard VOT's at satellite airports where no present service is provided.

c. Coordinate with the appropriate regional Flight Standards representative; e.g., FIP staff, prior to replacing a receiver checkpoint with VOT service, or prior to authorizing VOT service at a satellite airport.

d. Assure that the regional Frequency Management office has approved the proposed areas/altitudes before authorizing area use.

202.3 Flight Inspection Procedures. Recordings shall be made on all flight inspections to provide graphic data for analysis of signal intensity and station performance. Record crosspointer, flag alarm current, identification, and AGC on all checks.

202.31 Checklist. Perform the checks as noted below. Periodic requirements may be performed either on the ground or in the air within the areas approved for use.

Check	Ref. Para	C	P
Spectrum Analysis	202.3201	X	X
Identification	202.3202	X	X
Sensing	202.3203	X	X
Modulation Level	202.3204	X	X
VOT Reference Point	202.3205	X	
Alignment (Course Indication)	202.3206	X	X
Coverage	202.3207	X	X
Monitor	202.3208	X	
Standby Power	106.43	X	

202.32 Detailed Procedures. Airborne procedures do not apply if the VOT is not identified for airborne use.

202.3201 Spectrum Analysis. Evaluate the electromagnetic spectrum using a spectrum analyzer if interference is suspected. Record the measured frequency and detailed information on observed interference.

202.3202 Identification. The purpose of this check is to assure that the correct tone and identification are transmitted.

Two means of identification are used with these facilities, either a continuous series of dots, or a series of dots that cannot be interpreted as Morse code. Facilities maintenance personnel should be consulted for the proper identification. Record the commissioned identification on the facility data sheet.

Approved Procedure. For both standard and area VOT's, check the identification for correctness, clarity, and possible effects on the course indications throughout the areas of intended use (both in the air and on the ground).

202.3203 Sensing. This check determines and/or establishes the correct ambiguity of the transmitted signal.

Approved Procedure. While on the ground or in the air, check that the ambiguity indicates TO with 180° set in the omnibearing selector (OBS) and FROM with 360° set in the OBS, throughout the areas of intended use.

202.3204 Modulation Level. Since minor variations of the 30Hz AM, 30Hz FM, and 9960 will effect flight data, check the modulation levels throughout the areas of intended use. Measure and record modulation levels during all inspections.

Approved Procedure.

(1) Ground. Establish nominal values at the VOT reference point. Ensure that modulations remain within tolerance throughout all use areas.

(2) Airborne. Ensure that modulations remain in tolerance throughout all areas while conducting coverage maneuvers.

202.3205 VOT Reference Point. This check provides a designated area to begin an inspection or verify facility performance. The reference point shall be documented on the facility data sheet.

Approved Procedure

(1) Standard VOT. This check should be performed on the ground. Position the aircraft in an area of normal use for the VOT. It is recommended that the area chosen be the furthest distance from the facility maintaining line of site. Ensure signal quality and alignment are satisfactory in accordance with paragraph 202.5 When ground measurements are not practical, use the procedures outlined in paragraph 202.3205(2) to establish the reference point.

(2) Area VOT. This check may be performed on the ground or in the air. Position the aircraft over a known geographical point at the furthest point of intended use from the facility while maintaining line of site. Ensure signal quality and alignment are satisfactory in accordance with paragraph 202.5.

202.3206 Alignment. This check is performed to establish and/or verify the accuracy of the transmitted VOT courses throughout the coverage areas.

Approved Procedure. Establish the VOT course alignment at its optimum value (zero degree course error) at the VOT reference point.

(1) Commissioning. Use the procedure described in paragraph 202.3205(1).

(2) Periodic. Inspect the alignment of the VOT anywhere within the approved use areas. If the station alignment exceeds the tolerances specified in paragraph 202.5, recheck and reestablish the alignment (and monitors if necessary).

202.3207 Coverage. The purpose of this check is to ensure that adequate signal is received in all areas of intended use.

a. Approved Procedures.

(1) Standard VOT. Coverage is evaluated during a commissioning inspection concurrent with establishing the standard VOT Reference Point (see paragraph 202.3205(1)). For periodic inspections, evaluate coverage anywhere within the approved use area.

(2) Area VOT. Identify all the airports that the area VOT is to serve. Evaluate VOT performance at these airports in the air and/or ground, depending on air or ground use.

(a) Ground coverage is evaluated during a commissioning inspection concurrent with establishing the area VOT Reference Point (see paragraph 202.3205(2)). For periodic inspections, evaluate coverage anywhere within the approved area at each airport served.

(b) Airborne Coverage. Airborne coverage is evaluated during the commissioning inspection concurrent with establishing the approved use area. Since there is no standard service volume, the area is predicated on the need for VOT service, facility performance, and frequency protection. The most beneficial service can be provided by establishing an approved use area which is a fixed radius around the VOT site, normally 10 to 15 miles. An alternative to this method would be to fly a eparate 3-mile orbit around each airport where VOT service will be provided.

(c) Inspections. During the commissioning inspection, fly the orbits at the minimum and maximum altitudes at which VOT use will be authorized, normally between 1,000 and 5,000 ft. On periodic inspections, evaluate facility performance anywhere within the approved use area.

b. Restrictions to Coverage. Notify appropriate airport personnel of any areas within line-of-sight of the VOT in which sufficient signal is not available, then comply with paragraph 107.3

202.3208 Monitor. This check assures that a valid course is transmitted within specified values. For flight inspection purposes, the remote alarm unit shall be considered a part of the monitor.

Approved Procedure. Conduct this check at the VOT reference point or at any point on the airport where a valid signal is received.

(1) Have facilities maintenance personnel shift the course until the alignment monitor alarms. Record and measure the course.

(2) Have facilities maintenance personnel shift the course in the opposite direction until the alignment monitor alarms. Record and measure the course.

(3) Have facilities maintenance personnel return the course to normal. Record and measure the course.

202.3209 Standby Power. See paragraph 106.43.

202.4 Analysis. See paragraph 106.5.

202.5 TOLERANCES.

VOT GROUND USE AND AREA SERVICE

Parameter	Reference Para	Inspection C	Inspection P	Tolerance/Limit
Spectrum Analysis	202.3201	X	X	Interference shall not cause any out-of-tolerance condition.
Identification	202.3202	X	X	Correct, clear, without background noise. Readable throughout area of coverage. Identification shall not affect course characteristics.
Sensing	202.3203	X	X	TO with OBS set at 180°. FROM with OBS set at 360°.
Modulation Level 30 Hz AM, 30 Hz FM (3) and 9960.	202.3204	X	X	25 – 35% (optimum 30%)
Alignment	202.3206	X		0.0°
			X	1.0° or less.
Coverage (1)	202.3207			
Ground (Normal use areas)		X	X	15 µV minimum.
VOT Reference point	202.3205	X	X	15 µV minimum
Air		X	X	15 µV minimum throughout those areas/altitudes approved for use.
Monitor	202.3208	X	(2)	The course alignment monitor shall alarm when the course shifts exceed 1.0°.
Standby Power	202.3209	X		Tolerances for a facility on standby power should be the same as those on primary power.

(1) If the aircraft receiver is capable of measuring exact flag alarm current, apply a tolerance of 240 µA flag to all "coverage" checks.

(2) Check when alignment is found out-of-tolerance.

(3) When the 30 Hz signal is reported as a deviation ratio, the tolerance is 14.8 – 17.2.

SECTION 203

RESERVED

SECTION 204. VISUAL GLIDE SLOPE INDICATOR

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SECTION 204. VISUAL GLIDE SLOPE INDICATOR (VGSI)

204.1 Introduction.

a. The Visual Glide Slope Indicators (VGSI) are ground devices that use lights to define a vertical approach path during the final approach to a runway. The visual signal shall consist of not less than two and not more than four colors. Allowable colors are red, yellow, green, or white. Color sectors shall be distinct and identifiable throughout the horizontal beam width at all intensity settings. Only red is used to indicate the lowest below-path sector of the system.

b. The final approach area for VGSI's is 10^{o} either side of the runway centerline extended, measured from the forward most bar or light extending from the threshold outward to a point a normal glidepath can commence from the en route or procedural altitude. VGSI's are aligned to provide a glidepath not less than 1.0^{o} above obstacles 10^{o} either side of the runway centerline to a distance of 4 miles. Lateral guidance is obtained by reference to either visual cues or electronic aids.

c. Threshold crossing height (TCH) is the height of the lowest on-path signal at the threshold. The minimum TCH is determined by the most critical aircraft that normally operates on the runway. The TCH of VGSI's will normally be 25 to 75 ft. Specific TCH criteria for each type system is located in FAA Order 6850.2, Visual Guidance Lighting Systems.

d. There are several different types of VGSI's. The primary systems covered in this section are visual approach slope indicators (VASI), precision approach path indicators (PAPI), pulsating visual approach slope indicators (PVASI), T-VASI, three-color VASI, and helicopter approach path indicator (HAPI). Each of these systems presents a different type of visual indication to the pilot and requires different inflight interpretation.

e. Box Identification. The U.S. practice, as found in FAA Order 6850.5, Maintenance of Lighted Navigational Aids, is that individual VASI or PAPI light boxes are numbered starting at (1), with the box nearest the runway on each side and working outboard. ICAO Annex 14 and Aerodrome Design Manual reverse this, and number or letter the boxes starting with (1) or (A) at the outermost box and working toward the runway.

204.11 Visual Approach Slope Indicator System (VASI).

a. The VASI consists of either two or three light bars placed perpendicular to the runway. The light bars consist of one, two, or three boxes aligned on the left or both sides of the runway. Each box contains three high intensity lamps behind a horizontally divided filter with red colored and clear portions.

b. In using the systems, a pilot should fly through the light bar nearest the runway threshold (number 1 bar) until it appears WHITE, and undershoot the light bar beyond the touchdown point (number 2 bar) until it appears RED. The aircraft will be on the visual glide slope when the number 2 light bar appears RED and the number 1 light bar appears WHITE. When the aircraft deviates from visual glidepath, the pilot will see a change in color of one of the light bars. Deviation above the established glidepath will cause the number 2 light bar to fade from RED, through PINK, to WHITE, with the total change occurring within $1/4^{o}$ to $1/2^{o}$. Deviation below the glidepath will cause the number 1 light bar to change from WHITE, through PINK, to RED, within $1/4^{o}$ to $1/2^{o}$. A pilot sees two WHITE bars above glidepath and two RED bars below glidepath. (See Figures 204-D and G.)

c. The basic configurations of VASI are described below:

(1) Left Side of Runway.

(a) VASI-2 consists of two light boxes as shown in Figure 204-A. This system provides descent information under daytime conditions to a distance of 3 miles.

(b) Simplified Abbreviated Visual Approach Slope Indicator System (SAVASI-2) consists of two light boxes with a single lamp in each box as shown in Figure 204-A. This system is designed for nonjet, utility airports, and provides descent information under daytime conditions to a distance of 1.5 miles.

(c) VASI-4 consists of four light boxes installed as shown in Figure 204-B. This system provides descent information under daytime conditions to a distance of 4 miles.

(d) Walker 3-Bar VASI-6 is a 3-bar system installed as shown in Figure 204-E. Each bar consists of two light boxes aligned on the left side of the runway. The system provides descent information under daytime conditions to a distance of 3 miles.

(2) Both Sides of Runway.

(a) VASI-12 consists of 12 light boxes installed as shown in Figure 204-C. This system provides descent information under daytime conditions to a distance of 5 miles.

(b) VASI-8 consists of eight light boxes installed as shown in Figure 204-C. This system is basically the 12-box system with the outer four boxes removed and provides descent information under daytime conditions to a distance of 5 miles.

(c) Walker 3-Bar VASI-16 consists of 16 light boxes installed as shown in Figure 204-F. The system is basically a VASI-12 with the addition of an upwind 2-box light bar on each side of the runway. This provides an additional visual glidepath above and almost parallel to the normal path. The upper path is designed for high cockpit aircraft, ensuring a safe minimum wheel clearance over the runway threshold. This system provides descent information under daytime conditions to a distance of 5 miles.

204.12 Precision Approach Path Indicator System (PAPI).

a. The PAPI uses a two-color light projector system that produces a visual glidepath as shown in Figure 204-H. Each light box consists of at least two optical projectors that produce a single beam of light, the upper part of the beam is WHITE and the lower part RED. When passing through the beams, the transition from one color to the other is almost instantaneous.

b. There are two basic configurations of PAPI's that are described below:

(1) Four-Box System. The glidepath angle of a 4-box system is the midpoint of the angular setting of the center pair of light boxes. The on-path width is the difference between the angles of light boxes 2 and 3. Normal installation requires 0.33^{o} between light box settings 1 and 2, 2 and 3, and 3 and 4. Systems that support large aircraft require 0.50^{o} between light boxes 2 and 3. Tables 204-1 and 2 give the nominal box angles for all aircraft height groups. The on-glidepath indication is two RED and two WHITE lights on the light bar. When the aircraft goes below the glidepath, the pilot sees a progressively increasing number of RED lights, and if the aircraft goes above the glide slope, the number of WHITE lights increases as shown in Figure 204-I. This system provides descent information under daytime conditions to a distance of 4 miles.

(2) Two-Box System. This system is designed for utility type airports. The glidepath angle is the midpoint between the angular setting of the two light boxes. The on-path width of this system is normally 0.50^{o}, but may be reduced to provide obstacle clearance. The on-glidepath indication is one RED and one WHITE light. When the aircraft goes below the glidepath, the pilot sees two RED lights and two WHITE lights above glidepath. This system provides descent information under daytime conditions to a distance of 2 miles.

(3) Installation Convention. The system is normally installed on the left side of the runway but may be on the right or on both sides as shown in Figure 204-I.

204.13 Pulsating Visual Approach Slope Indicator System (PVASI). PVASI's normally consist of a single light unit projecting a two-color visual approach path as shown in Figure 204-J. The below glidepath indication may be pulsating or steady RED, and the above glidepath indication is normally pulsating WHITE. The above and below path pulsating lights appear to pulse faster the farther off path the pilot flies. The on-glide-path indication for one system is a steady WHITE light, and for another system the on-glide-path indication is an alternating RED and WHITE light. The on-path width of the steady WHITE light is approximately 0.35^{o} wide. This system provides descent information under daytime conditions to a distance of 4 miles.

204.14 T-VASI. The T-VASI presents a T-shaped light configuration as shown in Figure 204-K. The standard version has 10 lights on each side of the runway; the abbreviated AT-VASI is installed on only one side. If the aircraft is above the path, the vertical ‘stem’ of the T appears inverted above the horizontal path. The length of the stem is relative to the amount the aircraft is above the angle. As the aircraft nears the glide angle, the stem length decreases until it is not visible at the glide angle. As the aircraft goes below the glide angle, the stem of the T appears below the horizontal lights. When the aircraft reaches 1.9°, the lights turn RED, indicating well below glide path. When above the path, the fly-up lights should not be visible, and when below the path, the fly-down lights should not be visible.

204.15 Helicopter Approach Path Indicator (HAPI). The HAPI system, as shown in Figure 204-L, provides angular indications by changing light color between red and green and by pulsing the light. The on-path indication is a steady green light and, as the angle increases, the light flashes at a rate of at least 2 Hz. The slightly below path indication is a steady red indication, which turns to a flashing red indication at well below path. The width of the on-path should be 0.75°, and the width of the slightly below indication should be 0.25°.

204.16 Tri-Color VASI. The tri-color VASI (TRCV) is a single steady light that appears to change color in relation to the observer's angle. The on-path indication is a steady GREEN light, and the above path indication is AMBER. As the aircraft goes below path, a RED indication, sometimes preceded by a DARK AMBER, is seen.

204.2 Preflight Requirements.

204.21 Ground. In addition to preparations specified in Section 106.21, the facilities maintenance personnel shall:

a. Ensure that all lamps are operating.

b. Check the lamps for blackening and the lenses for cleanliness.

c. Check the setting of each box to determine proper angular adjustment.

d. Inform the flight inspection personnel of any unique siting conditions such as visual screening, waivers, or local restrictions.

204.22 Air. The flight inspector will comply with the preparations specified in Section 106.22. The flight inspector should review installation instructions and criteria contained in other appropriate directives.

204.3 Flight Inspection Procedures. Initial settings are determined by ground adjustments and verified by flight inspection. Flight inspection checks the overall appearance and usability of the system as viewed by the pilot on the approach, checks for coincidence of the VGSI's with other NAVAID's serving the same runway, and confirms obstacle clearance. Some of the detailed procedures below are type specific; adaptation of these procedures may be required for new or modified equipment types.

204.31 Checklist. Conduct a commissioning flight inspection when either a waiver is required or Airway Facilities or Airports Division makes a request. A commissioning inspection is required for all military facilities. Ground maintenance inspections maintain the VGSI's within operational tolerances, augmented by airborne surveillance inspections. Accomplish airborne surveillance inspections during routine inspections of nearby or associated primary navigation aids. There are no requirements to conduct periodic flight inspections of VGSI's.

Type Check	Ref. Para	Comm.	Surveil-lance
Light Intensity	204.321	X	X
Glidepath Angle	204.322	3	1, 3
Angular Coverage	204.323	X	
Obstruction Clearance	204.324	X	2
System Identification/ Contrast	204.325	X	X
Radio Control	204.326	X	X
Coincidence (ILS/MLS/PAR)	204.327	X	X

FOOTNOTES:

1 Check when coincidence with other NAVAID's has changed or other abnormalities are observed.

2 Check when new construction or questionable obstructions are identified in the final approach area.

3 Glidepath angle verification of FAA and Airport Improvement Program (AIP) funded VGSI's installed and ground checked using an FAA-approved aiming device, is not required unless requested.

204.32 Detailed Procedures.

204.321 Light Intensity.

a. General. Depending on the type of VGSI's and system design, the light intensity can be either manually or automatically controlled for daylight or darkness operations Some systems have three settings which allow for daylight, twilight, and dark operations. Maintenance can select one or two options for night operations to accommodate local site conditions for some systems.

b. Positioning. For facilities that are manually controlled, fly inbound while the controller changes the intensity settings to all operating ranges. Systems that use the automatic intensity settings should be checked the same as the manually controlled systems, if a method of changing the intensity is available. Intensity should be observed throughout the flight inspection.

c. Evaluation. Ensure all lamps are operating and are at the same relative intensity for each setting. If possible, the flight inspection should not be made during bright sunlight as it will reduce the effectiveness of the VGSI's. The normal intensity setting for daylight operation is 100 percent, for twilight periods 30 percent, and for hours of darkness 10 percent.

204.322 Glidepath Angle.

a. General. VGSI's provide vertical guidance for a VFR approach or for the visual portion of an instrument approach. The angle established by the VGSI's is referred to as the visual glidepath angle. The signal formats used to establish the visual glidepath angle can vary from a single light source, two or three light sources in a longitudinal array, and four or more light sources in a lateral and/or longitudinal array. Setting the required visual angle is a function of ground installation personnel. (See Figures 204-D and G.)

b. Positioning.

(1) Level Run Method. This method can be used at locations where ground checkpoint distances are known. Position the aircraft inbound on the runway centerline in the below path sector at the procedural intercept altitude or 1,000 ft AGL, whichever is higher. Proceed inbound while maintaining constant airspeed and altitude.

(2) On-Path Method. Position the aircraft inbound on the runway centerline in the below path sector at the procedural intercept altitude or 1,000 ft AGL, whichever is higher. Upon reaching the glidepath indications, begin a descent and keep the aircraft in the center of the on-glidepath indication.

(3) Theodolite Positioning. Position the theodolite beside the runway so the imaginary glidepath, originating from a point abeam the runway reference point (RRP), will pass through the theodolite eyepiece. The RRP is the point on the runway where the visual glidepath intercepts the surface.

c. Evaluation.

(1) Level Run Method. The level run crossing method may be used to determine the glidepath angle of VASI's during commissioning and subsequent surveillance inspections of all systems. Position the aircraft on the final approach with the recorder running. Maintain constant airspeed and altitude while marking the recording at each checkpoint. In addition to marking the checkpoints, the flight inspector marks the below path indication, the first on-path indication, the last on-path indication, and the first indication above path. The center of the on-path indications is used for computing the glidepath angle (see Section 302 for computation of angle). If a theodolite is used, the operator tracks the aircraft during the level run. The pilot calls when passing the below path sector, the on-path indication, and the above path indication. The theodolite operator records the angle of all three call outs; the on-path angle is considered the glidepath angle. The system angle is the average of at least two level run crossings.

(2) On-Path Method. The on-path method, using AFIS, or theodolite, may be used to determine the path angle of all VGSI types for all inspections. Altimetry may be used for all VGSI types, except PAPI, for all inspections. If theodolite is used, the operator tracks the pilot's window from the beginning of the inbound run. The pilot advises the theodolite operator when the aircraft is exactly on the measurement point. In the altimetry method, multiple on-path indications, and their corresponding distances along the approach, are noted. The distance indications may be from GPS, FMS, DME or INS, etc. The angle at each measurement point can be calculated using Formula 302.8b. These angles are then averaged to provide the run results.

(a) VASI, PVASI, T-VASI, TRCV, and HAPI should be measured at the center of the on-path indication as defined in paragraphs 204.11, 204.14, and 204.15.

(b) PAPI Evaluation. Determine the angle of individual light boxes by measuring the angle the light box changes color from WHITE to RED and from RED to WHITE. Fly the color changes of a single box and measure the angle at which it changes colors. The light box angle is the average of not less than four light color changes in each direction. The PAPI angle is the average between the angle of light boxes 2 and 3 of a 4-box system or light boxes 1 and 2 of a 2-box system as shown in Figure 204-H. For an accurate angle, you must average equal WHITE/RED and RED/WHITE calls; otherwise, the average is skewed in the direction of the larger number of calls. This is caused by the time delay in recognizing the color change, calling or marking the change, and recording the angle. There is no requirement to measure the angle of boxes 1 and 4 of a 4-box system unless, in the judgment of the flight inspector, the light boxes are out of symmetry with the overall system. If the symmetry is unacceptable, the angle of light boxes 1 and 4 should be measured so ground maintenance can make adjustments.

204.323 Angular Coverage.

a. General. VGSI's will provide coverage/ obstacle clearance 10° either side of the runway centerline extended, measured from abeam the first light bar/box. Fly a perpendicular crossing to determine the horizontal angular coverage of the VGSI's during commissioning inspections. In addition, this check is used to verify a restriction in coverage if a blanking device is used to limit coverage of a system due to obstructions or other hazardous situations. If an offset ILS/MLS is installed on the same runway as a VGSI (the VGSI will be aligned to the runway), the angular relationships must be carefully analyzed to determine the coverage suitability.

b. Positioning. Check the angular coverage by crossing the extended runway centerline at a 90° angle at a sufficient distance to enable the flight inspector to observe any shielding effect on the system. Conduct the maneuver at an altitude which provides an on-path indication.

c. Evaluation. Observe the point where the VGSI system becomes usable or unusable. The usable area is the angular coverage. For a system installed on only one side to be considered usable, all lights must be visible. For dual side installations, coverage from either side is required.

204.324 Obstruction Clearance.

a. General. The VGSI's must provide clearance above all obstacles within the commissioned operational service volume. Figures 204-D/H/J diagram the aiming of light boxes and installation obstruction clearance requirements for the different type VGSI systems. Flight inspection does not verify obstruction clearance as determined by site survey. It does verify that specific VGSI below path indications clear all obstacles within the commissioned operational service volume. The below-path approach is conducted during commissioning inspections and anytime there is a questionable obstruction to determine satisfactory guidance and obstruction clearances.

b. Positioning. Position the aircraft outside of the normal glide slope intercept distance below the glidepath. While proceeding inbound, a definite below path indication shall be visible on the VGSI's while maintaining clearance above all obstacles in the approach path. Conduct below path approaches on runway centerline extended and along each side of the angular coverage.

c. Evaluation. Obstacle clearance is checked by making approaches on runway centerline extended and along each side of the approach area from the point where the VGSI's angle intercepts 1,000 ft AGL or procedural altitude, whichever is higher. A definite climb indication must be evidenced by the system while maintaining clearance above all obstacles. If necessary, use a theodolite to verify a critical obstacle. The following climb indications must be visible while maintaining clearance above all obstacles:

(1) VASI. A definite RED/RED light must be visible on both upwind and downwind bars while maintaining clearance above all obstacles.

(2) PAPI. A definite RED must be visible on all light boxes while maintaining clearance above all obstacles.

(3) PVASI/HAPI. A definite flashing RED must be visible on the light unit while maintaining clearance above all obstacles.

(4) T-VASI. A definite RED must be observed on all 4 horizontal and all 3 vertical lights while maintaining clearance above all obstacles.

204.325 System Identification/Contrast.

a. General. VGSI's must provide a glidepath which is easily identifiable and readily distinguishable from other visual aids and aeronautical lights within the runway threshold and touchdown zone area.

b. Positioning. This evaluation is conducted during the other flight inspection maneuvers.

c. Evaluation. During the flight inspection maneuvers, observe if any surrounding lights or aircraft on taxiways interfere with the identification or use of the installed system. If there is any question of misidentification or interference, this inspection parameter should be checked at night. If a specific problem can be identified during the day, there is no requirement to confirm it at night.

204.326 Radio Control.

a. General. Commissioning flight inspection of the radio control system for VGSI's is only necessary when the VGSI's require a commissioning flight inspection in accordance with paragraph 204.31. When a commissioning flight inspection is not required, a check should be accomplished to verify system operation until a surveillance flight inspection can be performed.

Prior to a commissioning/surveillance inspection, the flight inspector should consult with the appropriate personnel to determine operational procedures and correct transmitter keying sequences.

b. Positioning. The aircraft should be positioned 15 to 25 miles from the airport at minimum line-of-sight altitude.

c. Evaluation. The sensitivity of the VGSI's ground radio control should be adjusted to allow facility activation when a proper radio signal is transmitted. Check for standardization of radio controlled lighting operations, as depicted in the Airmen's Information Manual. If Pilot-Controlled Lighting is inoperative, initiate NOTAM action and attempt to contact airport authority to have the lights manually activated for night or IFR use.

204.327 Coincidence (ILS/MLS/PAR).

a. General. When VGSI's and ILS, PAR, or MLS serve the same runway, the visual approach path should coincide with the one produced electronically. VGSI installations are engineered to provide close RRP coincidence with the RPI, using the same commissioned angle for both systems. Siting conditions affecting the electronic aid's achieved RPI may result in achieved RPI/RRP coincidence values beyond installation specifications, but satisfactory for use. Non-coincidence of angles and/or intercept points may be allowed, providing they are published as such. Approved waivers to electronic glide slopes shall apply to VGSI systems.

(1) Height Group 4. Some PAPI and PVASI are installed to serve aircraft in Height Group 4 (FAA Order 6850.2). The RRP of these systems is engineered to be 300 – 350 ft down the runway from the electronic RPI. PAPI or PVASI sited height group 4 must be identified in Airport/Facility Directories or similar publications.

(2) Barometric Vertical Navigation (VNAV) Instrument Procedures Development will cause VNAV path angles to be published on non-precision approaches. Whenever possible, the VGSI should be coincident with the VNAV path angle.

b. Positioning. For systems installed to support aircraft in Height Groups 1, 2, and 3, fly the electronic glide slope from approximately 2 nm to threshold. For PAPI/PVASI installed for Height Group 4, independently fly both the electronic and visual glide slopes. While flying the visual glide slope, monitor or record the ILS/MLS glide slope for expected ILS/MLS displacement at the 6,000 ft and 1,000 ft points.

c. Evaluation. Compare the electronic and visual glide slopes in the area between 6,000 ft and 1,000 ft prior to threshold for coincidence of runway point-of-intercept. For commissioning, both angles should be optimized if possible. For PAPI/PVASI sited for Height Group 4 aircraft, compare the achieved runway intersection points of both systems.

204.4 Analysis. Many factors, such as snow, dust, precipitation, color of background, terrain, etc., affect the pilot's color interpretation of the VGSI. Some deterioration of system guidance may occur as the pilot approaches the runway threshold due to the spread of light sources and narrowing of individual colors.

204.5 Tolerances. Classification of the system based on flight inspection results is the responsibility of the flight inspector. All systems shall meet these tolerances for an unrestricted classification. USAF/USN may commission facilities that do not meet the criteria for visual glidepath angle, glidepath coincidence, or RRP. VGSI system angle and the runway served are included in the routine FSS/commissioning message for appropriate publication.

a. Light intensity. All lights shall operate at the same relative intensity at each setting.

b. Visual Glidepath Angle.

(1) The visual glidepath is normally 3.0°, unless a higher angle is necessary for obstacle clearance or special operations. The angle must be published in the Airport/facility directory or similar publication.

(2) The effective glidepath angle shall be within 0.20° of the established or desired angle

(3) The visual and electronic glide slopes shall coincide in the area between 6,000 ft and 1,000 ft prior to threshold such that there are no conflicting indications that may result in pilot confusion. For PAPI/PVASI sited to support aircraft in Height Group 4, coincidence shall be considered satisfactory if the visual glide slope intersects the runway 300 to 350 ft past the point where the electronic glide slope intersects the runway.

c. Angular Coverage. The VGSI's shall provide guidance relative to the approach angle over a horizontal angle of not less than 10° either side of the runway centerline extended. When coverage or obstacle clearance is less than 10° either side of runway centerline, restrict the facility, issue a NOTAM, and ensure publication in the Airport/Facility Directory.

d. Obstacle Clearance. The visual glidepath shall be at least 1.0° above all obstacles in the final approach area. A definite fly-up indication shall be visible while maintaining clearance above all obstacles within the approach area.

e. Airfield/System Contrast. The system shall provide a glidepath signal which is easily identifiable and readily distinguishable from other visual aids and aeronautical lights within the installed environment. Misidentifying or failure to readily acquire the VGSI system will require an unusable status designation.

204.6 Adjustments. See paragraph 106.35.

TABLE 204-1
HEIGHT GROUPS 1 – 3 AIRCRAFT

BOX	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00
1	3.00	3.10	3.20	3.30	2.40	3.50	3.60	3.70	3.80	3.90	4.00	4.10	4.20	4.30	4.40	4.50
2	2.67	2.77	2.87	2.97	3.07	3.17	3.27	3.37	3.47	3.57	3.67	3.77	3.87	3.97	4.07	4.17
3	2.33	2.43	2.53	2.63	2.73	2.83	2.93	3.03	3.13	3.23	3.33	3.43	3.53	3.63	3.73	3.83
4	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50

TABLE 204-2
HEIGHT GROUP 4 AIRCRAFT

BOX	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00
1	3.08	3.18	3.28	3.38	3.48	3.58	3.68	3.78	3.88	3.98	4.08	4.18	4.28	4.38	4.48	4.58
2	2.75	2.85	2.95	3.05	3.15	3.25	3.35	3.45	3.55	3.65	3.75	3.85	3.95	4.05	4.15	4.25
3	2.25	2.35	2.45	2.55	2.65	2.75	2.85	2.95	3.05	3.15	3.25	3.35	3.45	3.55	3.65	3.75
4	1.92	2.02	2.12	2.22	2.32	2.42	2.52	2.62	2.72	2.82	2.92	3.02	3.12	3.22	3.32	3.42

Figure 204-A
VASI-2

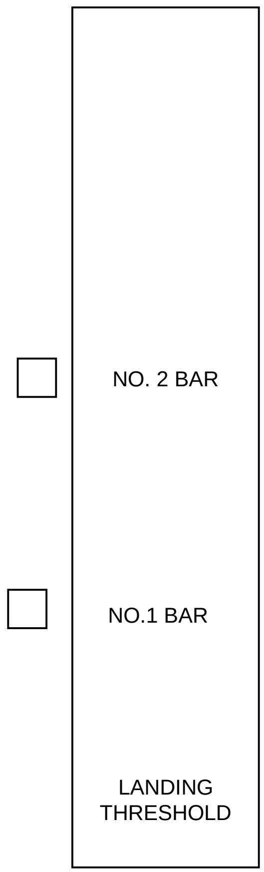


Figure 204-B
VASI-4 SYSTEM LAYOUT

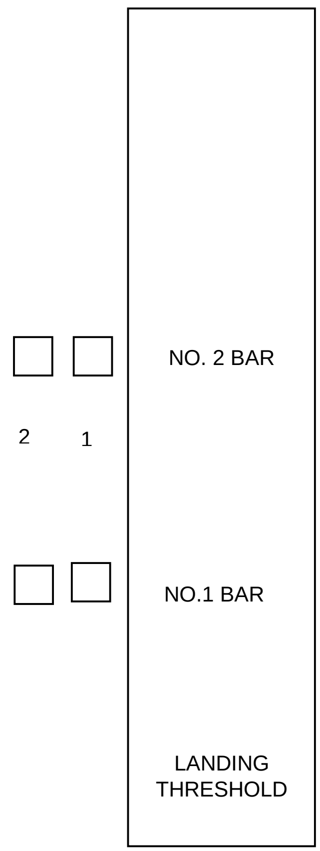


Figure 204-C
VASI-12 SYSTEM LAYOUT

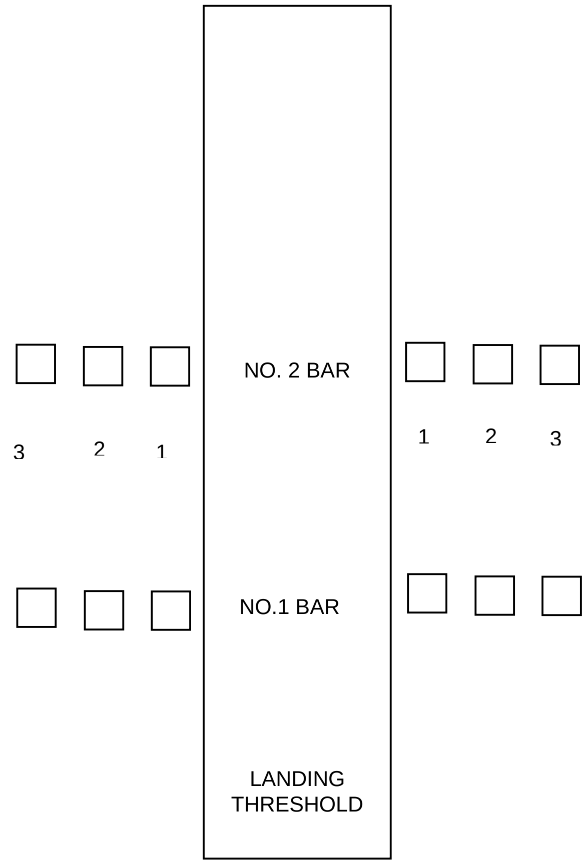


FIGURE 204-D. AIMING AND OBSTRUCTION CLEARANCE DIAGRAM FOR 2-BAR VASI

A = AIMING ANGLE, NO. 2 BAR

B = EFFECTIVE VISUAL GLIDE-
PATH ANGLE

C = AIMING ANGLE, NO. 1 BAR

T = EFFECTIVE VISUAL THRESHOLD
CROSSING HEIGHT

A = B = C + 1/2 DEGREE

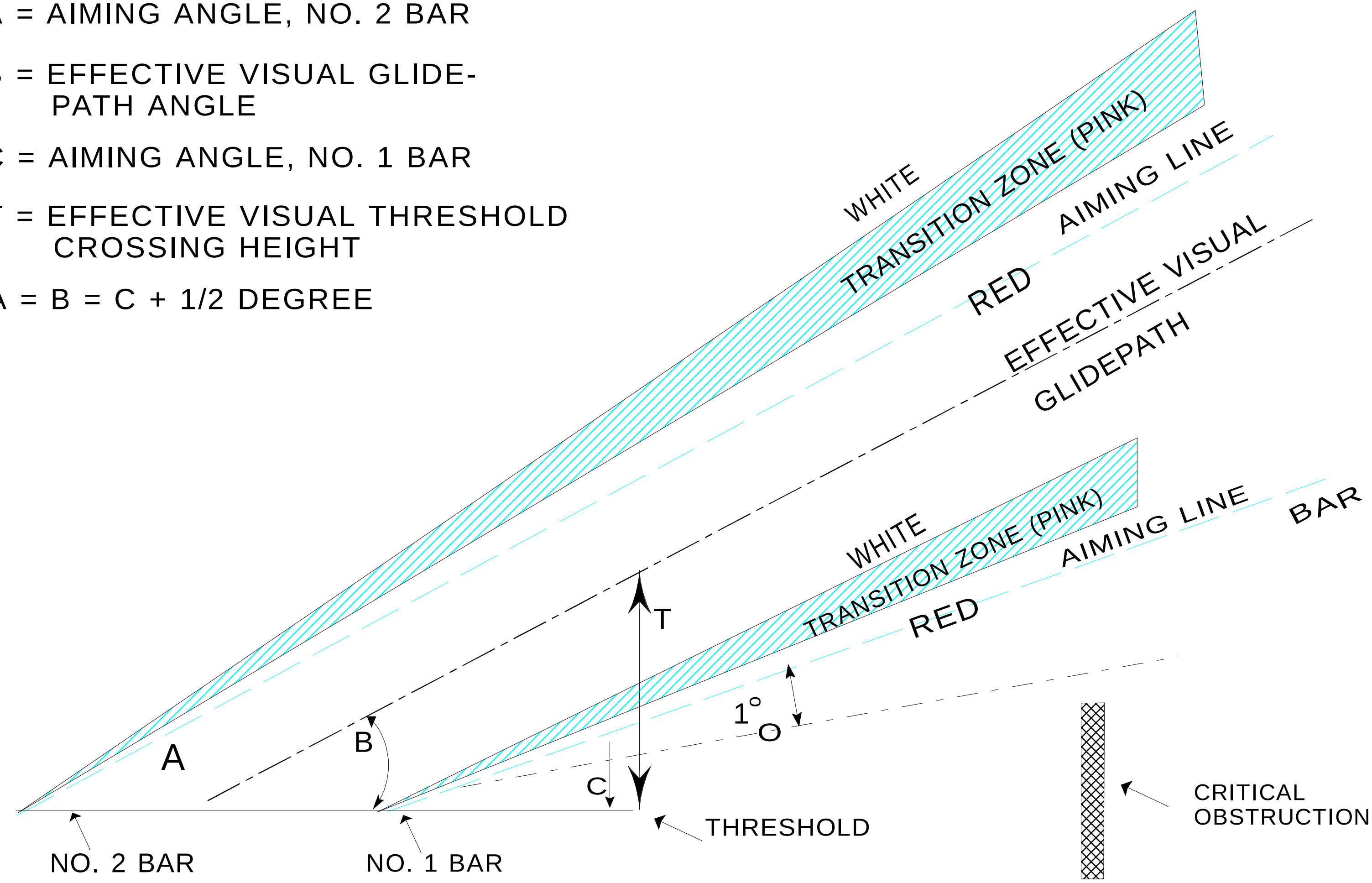


Figure 204-E
SYSTEM LAYOUT, WALKER 3-BAR VASI
(VASI-6)

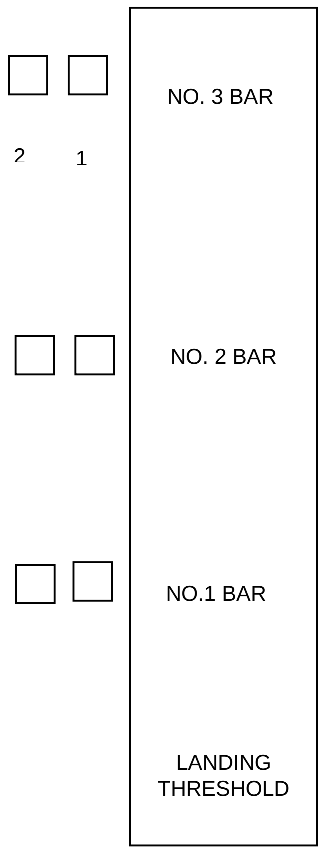


Figure 204-F
SYSTEM LAYOUT, WALKER 3-BAR VASI

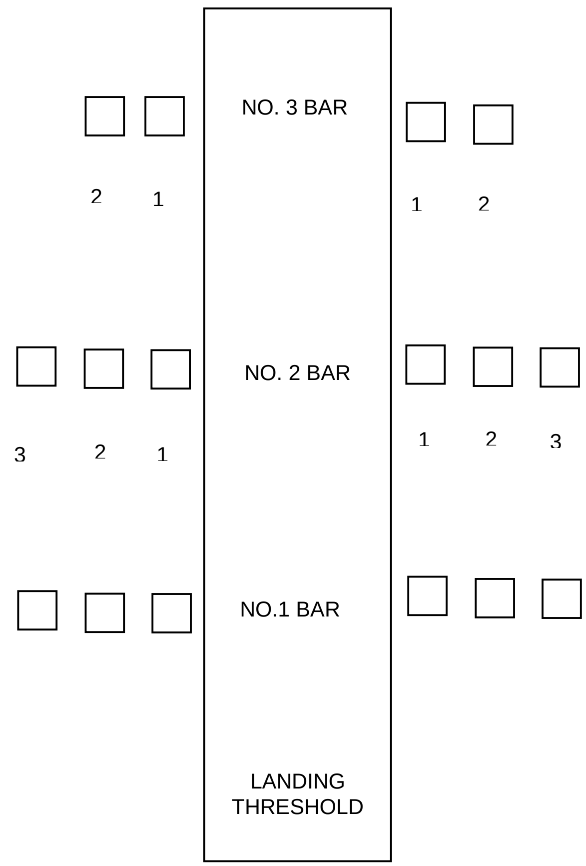


FIGURE 204-G. AIMING AND OBSTRUCTION CLEARANCE DIAGRAM FOR WALKER 3-BAR VASI

A = AIMING ANGLE, NO. 3 BAR = 3.25°

B = AIMING ANGLE, NO. 2 BAR = 3.0°

C = AIMING ANGLE, NO. 1 BAR = 2.75

T^1 = THRESHOLD CROSSING HEIGHT, LOW GLIDEPATH

T^2 = THRESHOLD CROSSING HEIGHT, HIGH GLIDEPATH

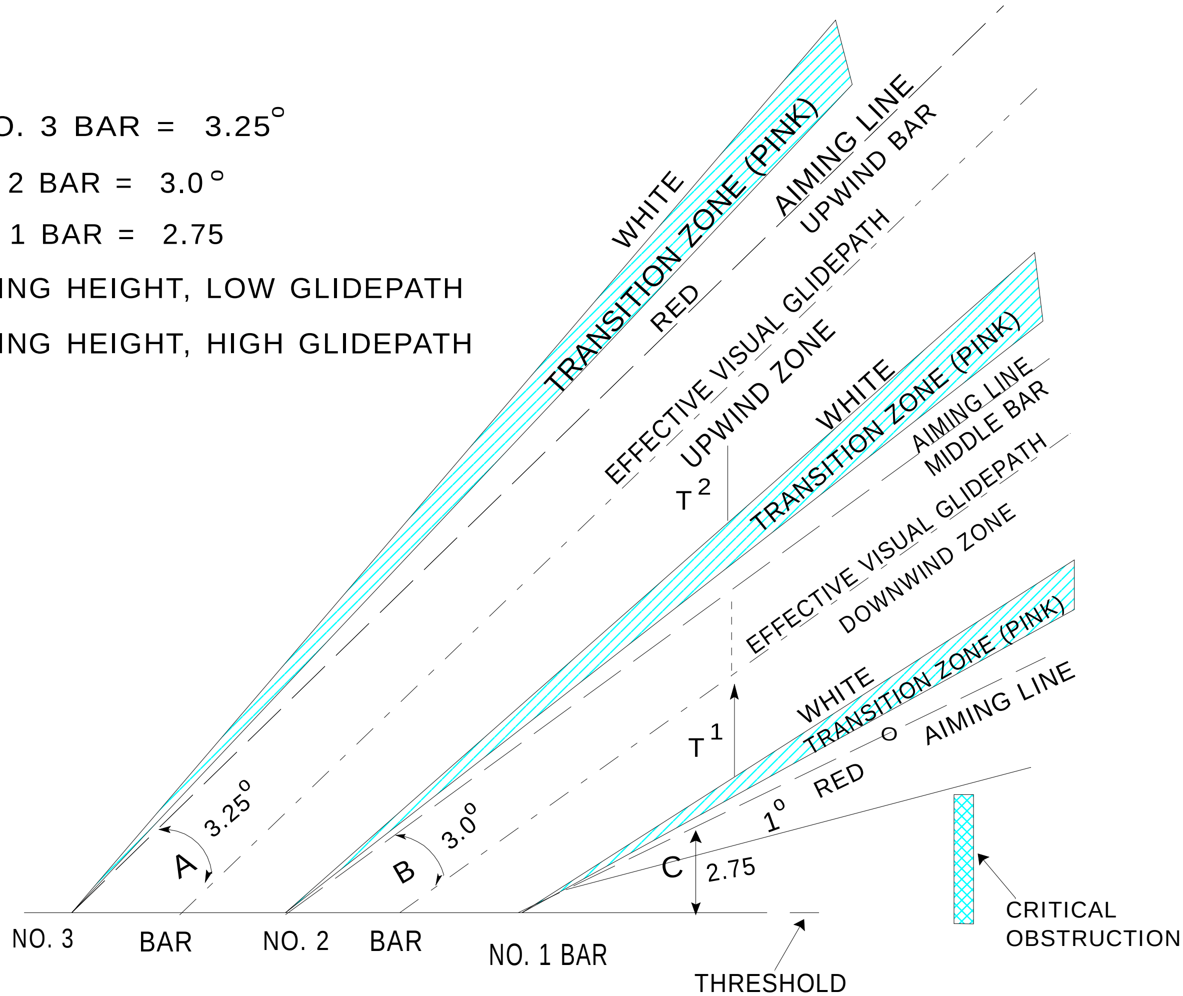


Figure 204H - PAPI APPROACH PATH (SIDE VIEW)

ϕ = Nominal Glide Path

( ) = Aiming Angle for Ht. Group 4 Aircraft on Electronic Glide Slope Runways

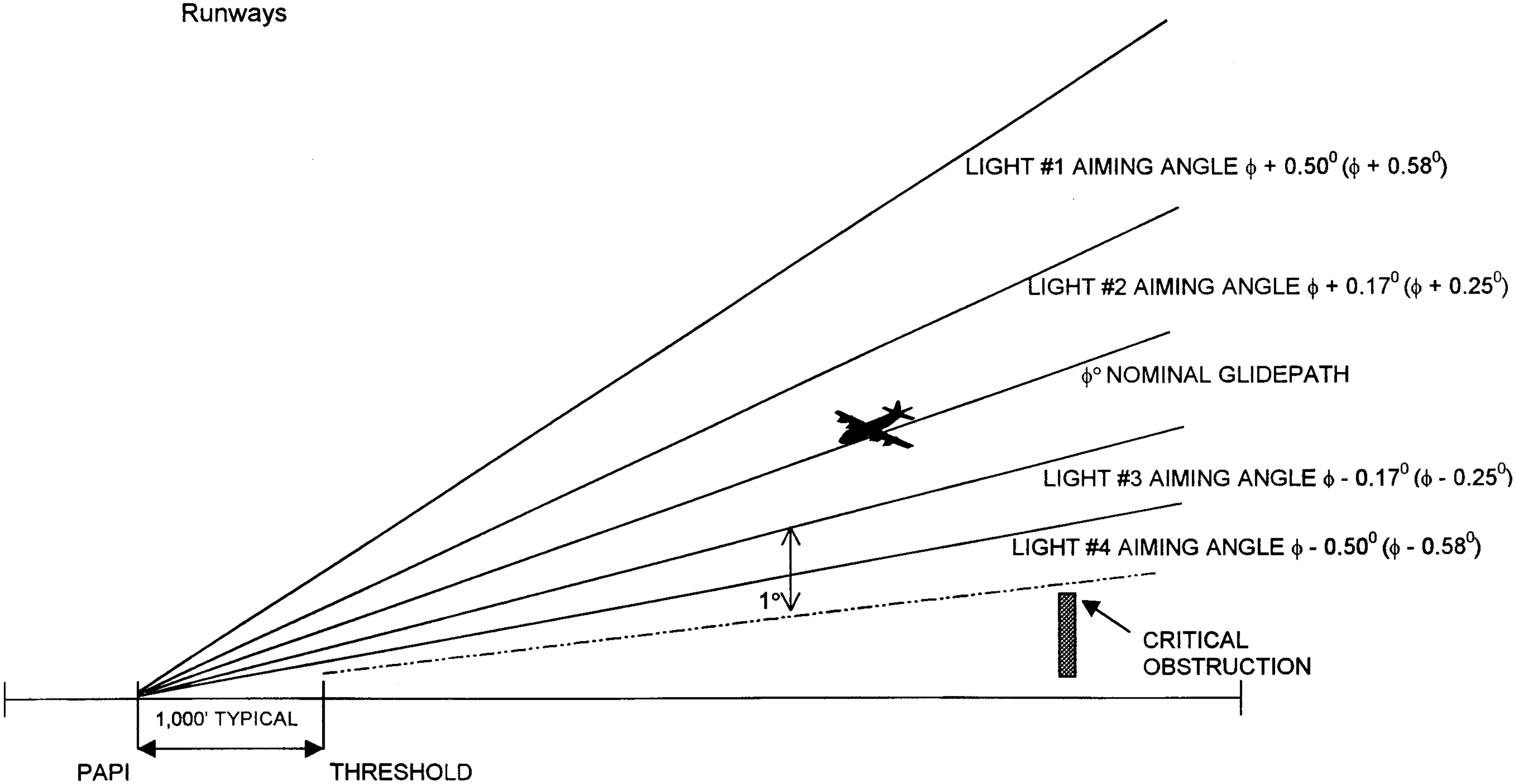


FIGURE 204-I. PAPI

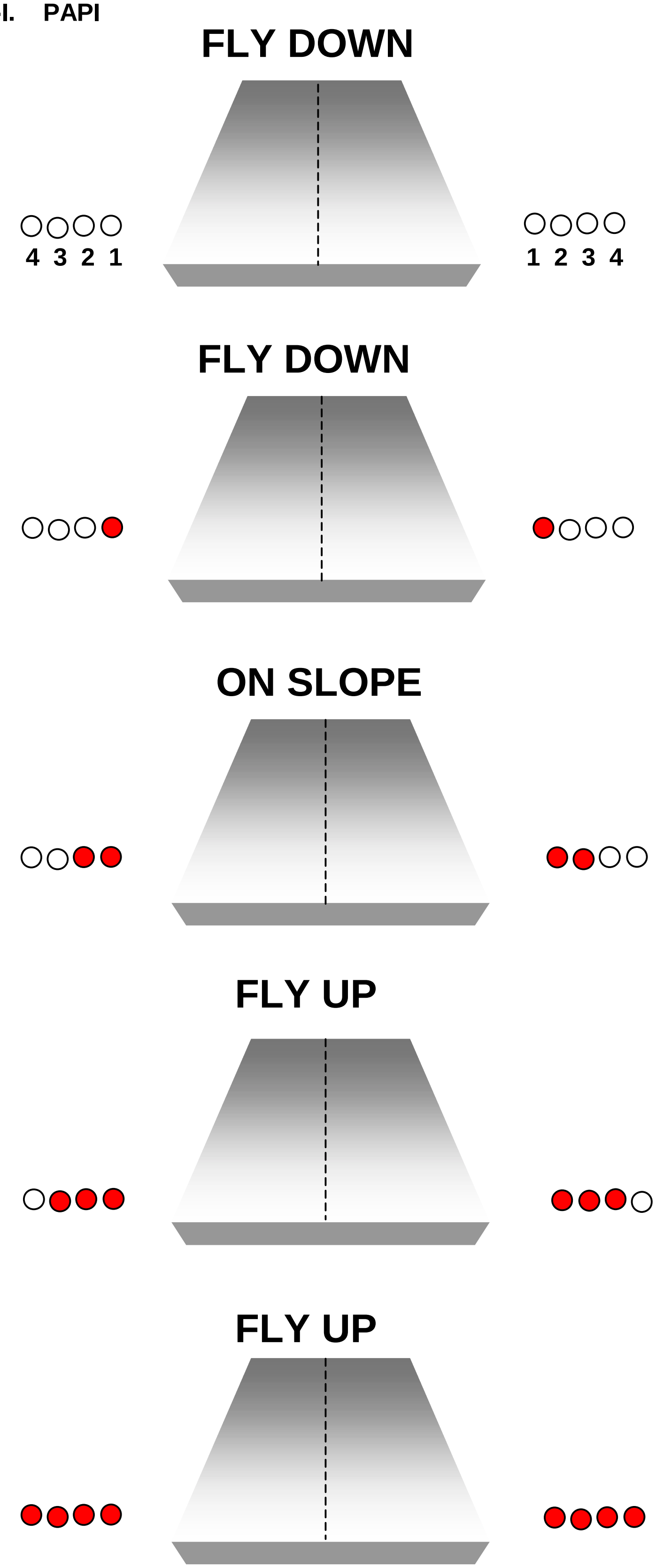
As you descend from WELL ABOVE the approach slope…
(All White)

to SLIGHTLY ABOVE the approach slope…
(3 White, 1 Red)

to ON the approach slope…
(2 White, 2 Red)

to SLIGHTLY BELOW the approach slope…
(1 White, 3 Red)

to WELL BELOW the approach slope…
(All Red)



…there is a progressive change from all white to all red lights.

Note: Normal installation is left side only, but may be both sides or right side only.

FIGURE 204-J. PVASI APPROACH PATH (SIDE VIEW)

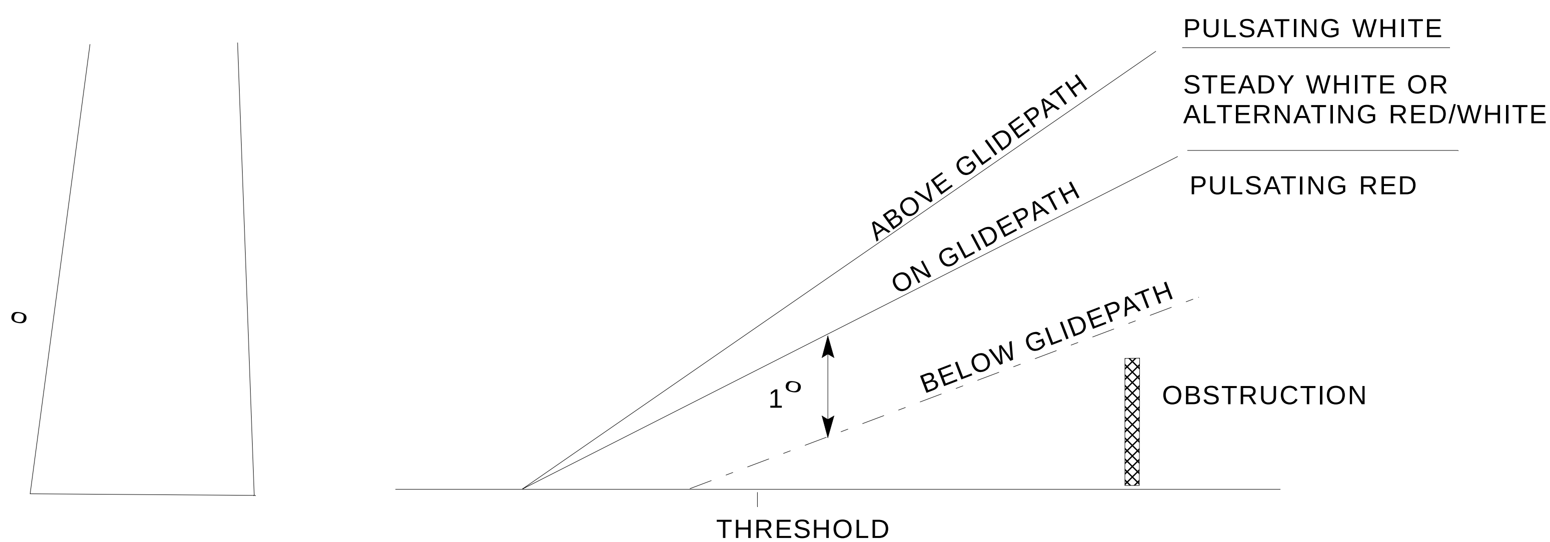
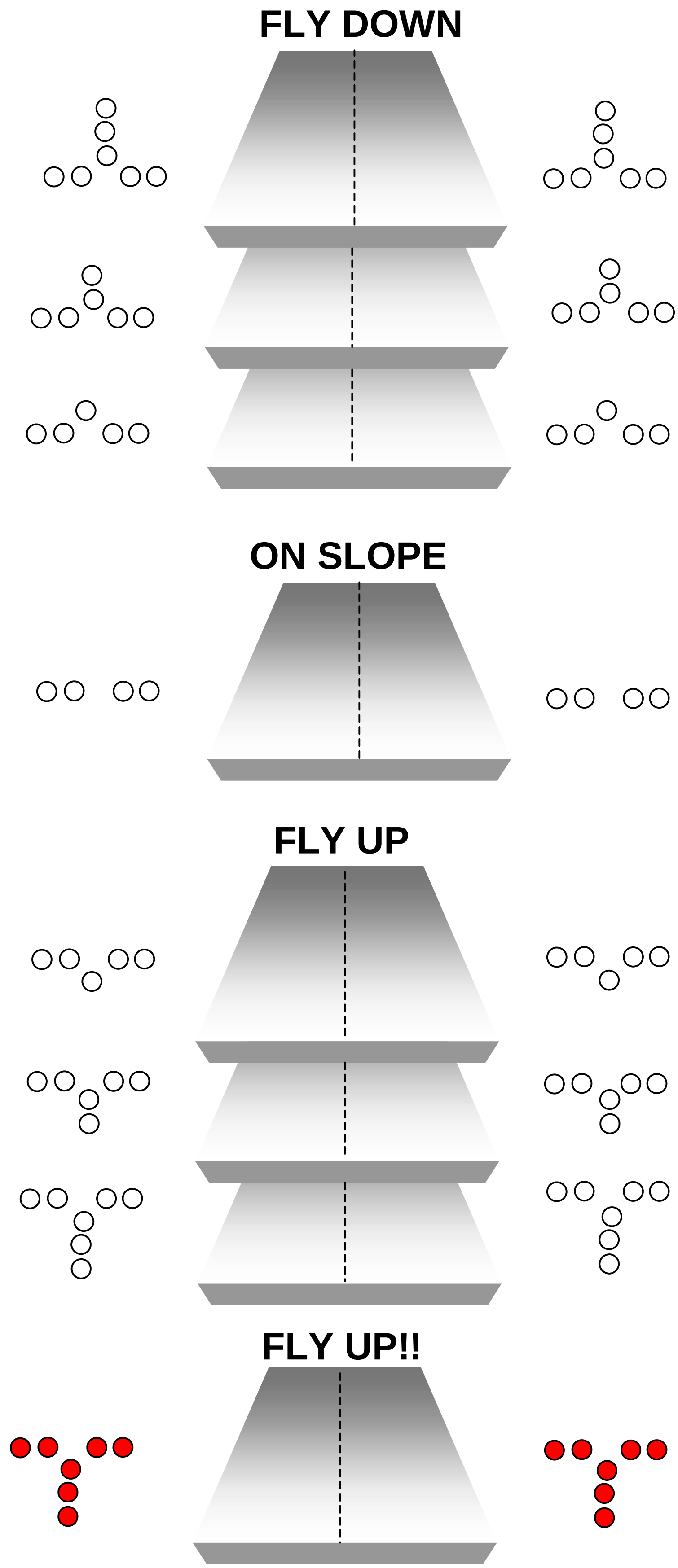


FIGURE 204-K T-VASI's



As you descend from WELL ABOVE the approach slope, the lights in the upper stem of the " ⊥ " will progressively disappear until…

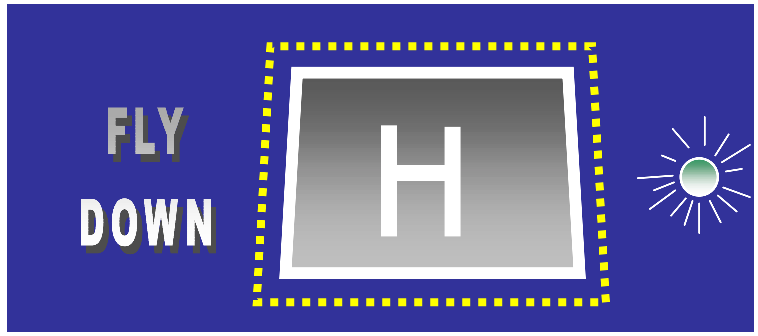
you are ON the approach slope….

Then if you descend BELOW the approach slope, the lights in the lower stem of the "T" will progressively appear.

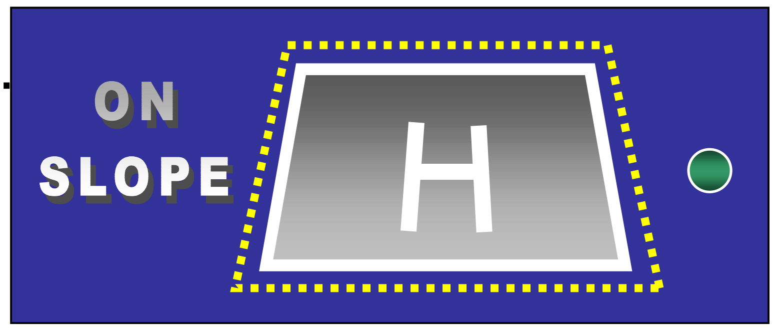
If all the lights of the "T" turn RED, you could be in serious trouble!

FIGURE 204-L HAPI

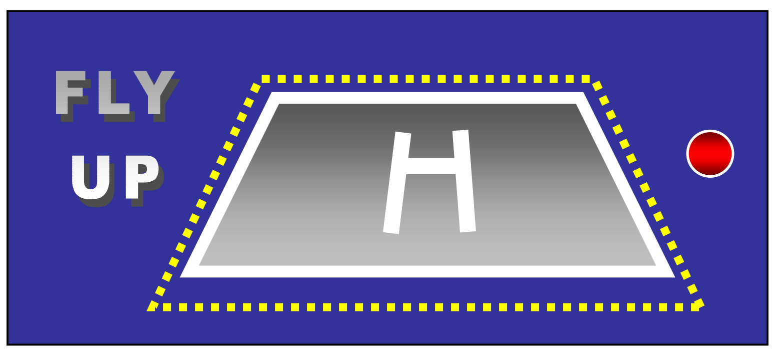
ABOVE
The approach slope…
(flashing green)



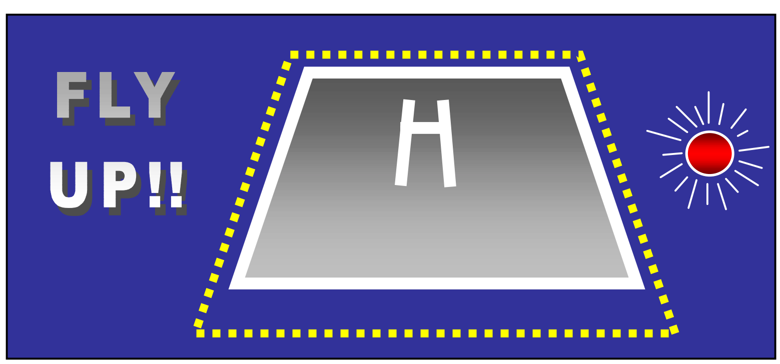
ON the approach slope…
(green)



SLIGHTLY BELOW
the approach slope…
(red)



TOO LOW!!
(flashing red)



SECTIONS 205 - 206

RESERVED

SECTION 207. LOW AND MEDIUM FREQUENCY NONDIRECTIONAL BEACONS (NDB)

SECTION 207. LOW AND MEDIUM FREQUENCY NONDIRECTIONAL BEACONS (NDB)

207.1 INTRODUCTION.

a. Low and medium frequency beacons transmit nondirectional signals on a continuous carrier keyed with either 400 or 1,020 Hz amplitude modulated Morse code identification. The carrier frequency bands are 190 to 535 kHz and 1,600 to 1,800 kHz.

b. Nondirectional Beacons are classified according to their intended use. The classifications are:

(1) Compass Locators (LOM, LMM if installed with marker beacons)
(2) MH Facility
(3) H Facility
(4) HH Facility

207.2 PREFLIGHT REQUIREMENTS.

207.21 Facilities Maintenance Personnel shall prepare for the specific inspection according to the procedures outlined in Section 106.

207.22 Flight Personnel. The flight crew shall adhere to the procedures outlined in Section 106. For a commissioning inspection, the flight inspector shall prepare a chart with the facility plotted and orbit depicted.

207.3 FLIGHT INSPECTION PROCEDURES. Flight inspection of the facility determines the facility coverage and quality of the signal. The flight inspector shall verify the accuracy of the Morse code identifier and check for interference during all inspections.

207.31 Checklist.

Type Check	Ref. Para	C	P
Identification	207.3201	X	X
Voice	207.3202	X	X
Coverage	207.3203	X	
	207.3204b		X
Standard Instrument	207.3204a	X	
Approach Procedure	207.3204b		X
Station Passage	207.3205	X	X
Standby Transmitter	207.3207	X	
Standby Power	207.3208 106.43	X	

207.32 Detailed Procedures.

207.3201 Identification. The flight inspector shall monitor the Identification during the evaluation for clarity and interference throughout the intended service volume.

207.3202 Voice. When installed, the voice feature enables the Nondirectional Beacon to transmit messages such as weather reports and observations. For commissioning inspections, the flight inspector shall ensure the facility complies with the tolerance of Para 207.5b and shall note the maximum distance that voice is clear and recognizable as a baseline for future inspections.

207.3203 Coverage. Coverage shall be evaluated by flying an orbit with the radius equal to the area of intended use per paragraph 207.5c(1). Commissioning will be at a power level determined by facility maintenance. The orbit altitude shall be 1,500 ft above facility site elevation, or the minimum altitude, which will provide 1,000 ft (2,000 ft in designated mountainous areas) above intervening terrain or obstacles, whichever is higher as determined by map study. Evaluate obstructions or hazards for impact on intended procedures and advise the Procedure Specialist. Evaluate the signal for excessive needle oscillation, weak or garbled ident, and interference throughout the entire orbit. Coverage at distances greater than the orbit radius will be certified for specific routes or transitions. The flight inspector shall fly intended routes or transitions at the minimum altitudes and maximum distances as depicted in the flight procedure document. For satisfactory performance, the facility shall meet the tolerances in paragraph 207.5. If the facility does not support the procedure, the flight inspector shall determine the minimum altitudes and maximum distances that meet all the tolerances in paragraph 207.5 and forward this information to the Procedure Specialist.

207.3204 Standard Instrument Approach Procedure (SIAP). The flight inspector shall follow the procedures for inspection of SIAP's contained in Section 214. Altitudes flown shall be the minimum proposed or published for the segment evaluated, except that the final segment shall be flown to 100 ft below the lowest published MDA. The flight inspector shall check to ensure compliance with tolerances in Para 207.5.

a. Commissioning Inspection of SIAP. The flight inspector shall evaluate all segments of the proposed procedure.

b. For a periodic inspection, evaluate the final approach segment of the SIAP IAW Section 214.

207.3205 Station Passage. Evaluate the area over the facility for correct indication of station passage. Needle reversal should occur when the aircraft passes directly over or in very near proximity to the station. If an indication of false station passage occurs during any evaluation, the facility shall be NOTAMed out of service and the cause investigated. Momentary needle hunting while over the station will not be construed as false passage.

207.3206 Expanded Service Volume (ESV) on commissioned facilities will be established at normal power.

207.3207 Standby Equipment. At facilities where dual transmitters are installed, the flight inspector shall check each for a commissioning inspection. The flight inspector shall also verify that the control station has transmitter selection capability.

207.3208 Standby Power. Refer to paragraph 106.43.

207.4 ANALYSIS.

a. Primary Means of Evaluation. The stability of bearing indications and the facility coded identification are the primary means of evaluating the Nondirectional Beacon.

b. Incorrect Bearing Indications. Erroneous bearing indications may have various causes, including weather phenomena, terrain, and radio interference. Analysis should encompass identification of anomaly cause when possible.

c. Application of Tolerances. The tolerances in this section are based on average atmospheric conditions. The flight inspector is expected to use good judgment in differentiating between facility performance and unusual atmospheric phenomena. To establish good facility performance baselines, commissioning flight inspections should be conducted in weather conditions that will not derogate or enhance facility performance.

207.5 TOLERANCES. Nondirectional Beacons that meet tolerances throughout the area of intended use are classified as UNRESTRICTED. Facilities that do not support routes or transitions outside of coverage as listed in paragraph 207.5c(1) will not be restricted, but use of the facility for that purpose will be denied.

a. Morse Code Identification. All facilities shall have a Morse code identifier that is correct, clear, and identifiable throughout the area of intended use, including any route or transition that may extend beyond the normal service volume. If the Morse identifier is augmented with voice identification, the voice shall adhere to the same tolerance as the associated Morse identifier.

b. Voice Transmission. Broadcast information shall be clear and recognizable for a minimum of two-thirds of the Nondirectional Beacon's usable distance.

c. Usable Distance.

(1) The minimum usable distance shall be:

(a) Compass Locator 15 nm

(b) MH Facility 25 nm

(c) H Facility 50 nm

(d) HH Facility 75 nm

(2) Maximum bearing deviation:

20° (± 10°).

d. NDB Approach. Bearing indicator deviation in the final approach segment shall not exceed:

10° (± 5°)

e. Bearing Tolerance Deviation. Short duration, out-of-tolerance needle activity (including repetitive events) will be allowed when either:

(1) the duration does not exceed four seconds on an approach (flown at a nominal 130 knot ground speed), or

(2) the duration does not exceed eight seconds for en route use;

but only if the out-of-tolerance activity cannot be construed as a station passage, and the activity is not generally one-sided when repetitive.

f. Station Passage. Station passage indications shall occur over the ground facility.

g. Standby Equipment. If installed, standby equipment shall perform to all tolerances in this section.

207.6 ADJUSTMENTS. Requests for adjustment shall be specific. The flight inspection crew will furnish sufficient information to enable maintenance personnel to make adjustments. Adjustments which affect facility performance shall be rechecked by flight inspection.

SECTION 208. UHF HOMING BEACONS

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SECTION 208. UHF HOMING BEACONS

208.1 Introduction

a. The UHF Homing Beacon (AN/URN-12) ground station transmits a continuous carrier in the frequency range of 275 to 287 megacycles, modulated with a 1,020-cycle tone for identification purposes. The power output is approximately 15 watts.

b. The pilot of an aircraft equipped with the AN/ARA-25 or similar equipment can determine the relative bearing of, and "home" on, the facilities maintenance equipment. The airborne equipment extracts the information from signals received by the AN/ARC-27 or similar UHF communications receiver. The relative bearing of the signal source is indicated on a course indicator. Best results are obtained under straight and level flight conditions.

208.2 Preflight Requirements

208.21 Facilities maintenance personnel should prepare for flight inspection in accordance with procedures outlined in Section 106.21.

208.22 Air. The flight inspector will prepare for the flight inspection in accordance with procedures outlined in Section 106.22. In addition to the above preparations, the flight inspector will:

a. Be sure that an approved type of airborne equipment is installed and has been calibrated and aligned in accordance with current FAA directives.

b. For commissioning, use a suitable chart, scale 1:500,000 or greater, to plot the exact location of the facility. Plot a series of check points spaced approximately 45° apart at a radius between 20 and 30 nm from the station. Determine the primary air routes that are served by the facility and plot the routes on the chart. Select two courses for a long-distance check. Note: These two courses may be extensions of the primary air routes previously selected, but should be at least 45° apart.

208.3 Flight Inspection Procedures. The primary object of the flight inspection is to determine the coverage and quality of the transmitted signal; therefore, it is necessary that the aircraft be flown through normal usage patterns and procedures to determine the usability of the facility and to ensure that the homing beacon meets the operational requirements for which it was installed.

208.31 Checklists.

Type Check	Reference Paragraph	C	P
Station identification	208.3201	X	X
Bearing accuracy	208.3202	X	X
Voice	208.3203	X	X
Coverage	208.3204	X	X
Long distance	208.3205	X	
Low approach	208.3206	X	X
Station passage	208.3207	X	X
Standby equipment	208.3208	X	X
Standby power	106.43	X	

208.32 Detailed Procedures.

208.3201 Station Identification. Select the proper frequency and check for correct identification and tone of the signal. Any discrepancies noted should be reported to maintenance personnel for corrective action before continuing the flight inspection. Note any frequency interference from other stations.

208.3202. Bearing Accuracy. Check bearing accuracy against AFIS, GPS, or map reference at least at one point in the service volume, preferably on a published procedure. Fly at minimum instrument altitudes or at an altitude to ensure adequate signal strength.

208.3203 Voice. If the facility is equipped with voice feature, this feature should be checked at maximum usable distance. It will be noted that most types of airborne equipment will require the receiver function selector to be placed in the RECEIVE position to receive voice transmissions. Request a long voice transmission and note the voice quality, modulation, and freedom from interference. In the event voice transmissions do not reach the maximum usable range, return inbound until they can be received satisfactorily. Record this distance on the flight inspection report.

208.3204 Coverage

a. Proceed outbound along one of the primary air routes at minimum instrument altitude until reaching 45 nm or until any out-of-tolerance condition is observed. This position will be the usable distance. Upon completion of the investigation of the first route, proceed to the remaining routes and repeat the above procedures.

b. During the check, observe the surrounding terrain and note the location of terrain, or other obstructions that may prevent line-of-sight transmissions to an area beyond the obstructions. Reflections of radio signals, or shadow effect, caused by the intervening terrain, or other obstacles, may result in bearing errors or loss of usable signal.

c. If areas of weak signal are encountered or if terrain obstructions exist, investigate the areas in question and record the areas checked, location of apparent obstructions, and the minimum altitude and distance at which a usable signal can be received.

d. For periodic inspections, check coverage from 45 nm at minimum en route altitude until intercepting the approach procedure.

208.3205 Long-Distance Check. Proceed outbound along one of the air routes or courses selected to a distance of 100 nm at an altitude of 10,000 ft. Observe and record the extent of the pilot's direction indicator needle oscillation, AGC, and the station identification. Then proceed to the other air route or selected course at the 100-mile range and fly inbound along this route to the facility site, again noting the identification, AGC, and needle oscillation.

208.3206 Standard Instrument Approach Procedure (SIAP). If this facility is to be used as a low approach aid, a low approach will be made for each of the proposed or approved procedures. Check each approach procedure for flyability. Unusual conditions noted will be further investigated. The flight inspector shall follow the procedures for inspection of SIAP's contained in Section 214. Altitudes flown shall be the minimum proposed or published for the segment evaluated, except that the final segment shall be flown to 100 ft below the lowest published MDA. The flight inspector shall check to ensure compliance with tolerances in Para 208.5.

a. Commissioning Inspection of SIAP. The flight inspector shall evaluate all segments of the proposed procedure.

b. For a periodic inspection, evaluate the final approach segment of the SIAP.

208.3207 Station Passage. Fly over the antenna site and note the position where station passage is indicated. The station passage should be indicated by a sharp positive reversal of the pilot's direction indicator needle. No specific tolerances are established for station passage; however, it should be encountered approximately over the facility. Any area where the needle has a tendency to reverse itself before actually passing over the station should be plotted on the chart and reported on the flight inspection report.

208.3208 Standby Equipment. Standby equipment will be spot-checked to ascertain that it meets the same tolerances as the primary equipment.

208.4 Analysis

a. From the data obtained during the flight inspection, the flight inspector must determine if there are any areas where the facility fails to meet the coverage and/or bearing tolerance. If such areas were noted during the flight inspection, he should analyze all data to determine if such effects are caused by terrain or equipment. Normally this facility cannot be expected to give reliable information at ranges and altitudes which are below line of sight.

b. The airborne ADF equipment (AN/ARA-25) is an attachment applied to the UHF transceiver to enable it to take bearings on a transmitted signal. While in the ADF position, the ADF antenna seeks a null in the process of presenting a bearing. Under these conditions, very little signal from the transmitter is applied to the UHF transceiver, and tone identification cannot be heard at distances greater than 70 nm, line of sight, but may be heard at shorter distances depending upon the ambient electrical noise level of the airborne ADF system. (The antenna drive mechanism develops a 100-cycle signal that is great enough to blanket the tone identification except at close range to the transmitter.) Continuous switching from the RECEIVE to ADF position must be accomplished in order to monitor both the identification and the ADF indications.

c. The bearing indicator normally hunts plus or minus a few degrees of the received bearing when the transmitter is operating satisfactorily. In the absence of a carrier, the bearing indicator usually rotates slowly and continuously over 360° of azimuth, or remains stationary. For this reason, the station must be monitored intermittently in the RECEIVE and ADF position.

208.5 Tolerances. All UHF Homers will meet these tolerances for an UNRESTRICTED classification. Classification of the facility based on flight inspection results is the responsibility of the flight inspector.

a. Identification. Station Identification will be correct, clear, and intelligible.

b. Bearing Error.

(1) maximum bearing error will not exceed ±5°.

(2) ADF needle oscillation will not exceed ±5°.

c. Voice. If provided, will be clear and readable at distances equal to or greater than two-thirds of the maximum usable distance of the facility.

d. Coverage. Usable distance will not be less than 45 nm at minimum instrument altitude.

e. Station Passage. At all altitudes, the needle reversal shall occur approximately over the ground facility. (Any condition of false reversal attributable to the ground facility shall require a notice to airmen.)

f. Standby Equipment. Standby equipment will meet the same tolerances as specified for the primary equipment.

SECTION 209. AREA NAVIGATION (RNAV)

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SECTION 209. AREA NAVIGATION (RNAV)

209.1 INTRODUCTION. Area Navigation (RNAV) is a method of navigation that permits aircraft operation on any desired course within the limits of a self-contained system capability. Many systems also provide vertical guidance. Flight Management Systems (FMS) with multiple sensors and Global Positioning System (GPS) navigators are most common. These systems navigate with reference to geographic positions called waypoints. Reliance on RNAV systems for departure, en route, and approach operations will increase as new systems are developed. Multi-sensor RNAV equipment determines aircraft position by processing data from various input sensors. Aircraft position may be fixed by various methods, depending on factors such as availability of sensors, signal parameters, location and/or flight phase. Unlike early RNAV systems which used only VOR/DME rho-theta for position fixing, multi-sensor navigation systems employ a variety of sensors, such as: distance measurements from two or more DME ground stations (DME/DME), VOR/DME, inertial reference unit (IRU), Loran-C, and GPS. These various sensors may be used by the navigation computer individually, or combined in various ways (based on internal programming) to derive aircraft position. Navigation values, such as distance and bearing to a waypoint (WP), are computed from the derived latitude/longitude and the coordinates of the waypoint. Course guidance is generally provided as a linear deviation from the desired track of a great circle course. The desired course may be pilot selectable (e.g., pseudo course or go direct) or may be determined automatically by the navigation computer, based on the locations of successive waypoints (point to point).

The FAA has developed a new charting format for RNAV Standard Instrument Approach Procedures (SIAP). This format maximizes the information available to the pilot for the safe and efficient conduct of the instrument procedure. Stand-alone FMS and GPS approach charts will be replaced with the RNAV charting format.

RNAV charting provides separate minima for GPS Landing Systems (GLS), Lateral Navigation (LNAV), and Lateral and Vertical Navigation (LNAV/VNAV). Flight inspection of an LNAV procedure (without vertical navigation) can be accomplished with any flight inspection aircraft. Inspection of a GLS or LNAV/VNAV procedure requires the flight inspection aircraft to have vertical navigation capability.

LNAV and LNAV/VNAV approach procedures consist of sequenced waypoints. Terminal Segments are Initial Approach Waypoint (IAWP), Intermediate Waypoint (IWP), Final Approach Waypoint (FAWP), Missed Approach Waypoint (MAWP), Missed Approach Turning Waypoint (MATWP), and Missed Approach Holding Waypoint (MAHWP).

a. Flight Management System (FMS). The FMS is a computer system that uses a large database to allow routes to be pre-programmed and fed into the system by means of a data loader. The system is constantly updated, with respect to position accuracy, by reference to ground and/or space-based navigational aids. The program and its associated database ensure that the most appropriate aids are automatically selected during the information update cycle.

Some RNAV procedures now include vertical guidance. Vertical guidance is provided as a linear deviation from the desired track, defined by a line joining two waypoints with specified altitudes, or as a vertical angle from a specified waypoint. Computed positive vertical guidance is based on barometric, satellite elevation, or other approved systems. The desired vertical path may be pilot selectable, or may be determined by the VNAV computer, with computations based on the altitudes associated with successive waypoints.

FAA flight inspection aircraft use the Universal UNS-1 FMS. This system allows a flight plan vertical Flight Path Angle (FPA) entry from a pilot-defined flight plan. The UNS-1 FMS uses “baro VNAV” for vertical guidance. The altimeter shall always be the primary altitude reference for all flight operations.

b. Global Positioning System (GPS). The Global Positioning System (GPS) is a Department of Defense (DoD) operated global coverage, satellite-based navigation system. It provides standard positioning service (SPS) to all equipped users, plus precision position service (PPS) to DoD and other specially equipped users.

GPS is an Earth Referenced Navigation (ERN) system that consists of three distinct functional segments; the **space segment, control segment** and **user segment.**

The **space segment** consists of a satellite constellation in six orbital planes (with four in each plane) at approximately 11,000 miles above the earth. The **space segment** provides the signal structure necessary for user equipment to determine time and a position fix in terms of latitude, longitude, and altitude as required. The GPS constellation broadcasts a pseudo-random code-timing signal and data message that the airborne equipment processes to obtain satellite position and status data. By knowing the precise location of each satellite and precisely matching timing with the atomic clocks on the satellites, the airborne receiver can accurately measure the time each signal takes to arrive at the receiver and determine aircraft position.

The satellites radiate on two frequencies; L1 at 1575.42 MHz and L2 at 1227.6 MHz. The satellites transmit their signals using spread spectrum techniques, employing two different spreading functions: a 1.023 Mbs coarse/acquisition (C/A) code on L1 and a 10.23 Mbs precision (P) code on both L1 and L2 transmitted in phase quadrature. Total bandwidth around each carrier is 20.46 MHz. Superimposed on both the C/A and P-code is the navigation message containing satellite ephemeral data, C/A to P-code hand-off, atmospheric propagation correction data, and satellite clock-bias information. This data is transmitted at 50 bps. The minimum power level (signal strength) available at the output of the user antenna is -160 dBW.

The GPS **control segment** is responsible for monitoring the status of each satellite and updating the navigation data transmitted by each satellite. This segment consists of the master control station, five monitoring stations, and three up-link antenna facilities. Satellite information is transmitted from the monitor stations to the master control station. The master control station uses this information to update the contents of the navigation data via the ground up-link antennas.

The **user segment** consists of antennas and receiver-processors onboard the aircraft that provide position, velocity, and precise timing to the user. The GPS receiver calculates a position fix using a ranging technique. The user equipment determines the pseudo-ranges from at least four satellites to calculate the receiver's internal clock offset and the three-dimensional position fix. The signal transmitted by each satellite is modulated with data that defines the satellite's position (ephemeral), the GPS system time, its clock error, and the health and accuracy of the transmitted data. The user equipment is able to decode this information and determine where the satellite is located at any given time (pseudo-range).

Selective Availability (SA) is a method by which the DoD can artificially create a significant clock and ephemeris error in the satellites. This technique is designed to deny any enemy the use of precise GPS position data. SA is the largest source of error in the GPS system. When SA is active, the DoD guarantees horizontal position accuracy of the SPS will not be degraded beyond 100 meters 95 percent of the time and 300 meters 99.99 percent of the time. All SPS system performance specifications assume SA is active.

c. Loran-C is a low frequency radio navigational aid operating in the radio frequency spectrum of 90 to 110 kHz. The United States Coast Guard operates the U.S. station transmitters. The transmitting system is essentially a closed loop and self-monitoring one that prevents any control of adjustments by FAA personnel. Therefore, the flight inspections referred to in this chapter are SIAP's.

(1) All Loran-C signals are modulated and pulsed with unique synchronizing pulses, repetition rates, and phasing codes centered about 100 kHz. Using this information, a receiver identifies individual transmitters. The receiver measures the time interval between the reception of specific transmitter signals, and calculates position coordinates and course guidance information.

(2) Loran-C signals are used for en route and terminal navigation. Specific CHAIN and TRIAD stations must be used and certified for instrument approach procedures by flight inspection. These same stations must be monitored by a local area monitor. This monitor records timing information that determines receiver time difference calibration values. These calibration values are necessary to ensure repeatable approach accuracies during all seasons.

209.2 PREFLIGHT REQUIREMENTS. The flight inspector shall prepare for the flight inspection in accordance with the procedures outlined in Section 106.

a. LNAV approach procedures consist of sequenced waypoints. The entire flight plan of waypoints shall be entered into the FMS or GPS receiver for commissioning flight inspections, and, when available, selected from the database for periodic inspections. Enter the final approach waypoints for periodic inspections for those GPS or FMS procedures to runways less than the minimum length for inclusion in the database.

b. LNAV/VNAV

(1) Aircraft Requirements. Inspection of an LNAV/VNAV procedure requires the flight inspection aircraft to have vertical navigation capability. If any part of the procedure cannot be evaluated adequately using flight inspection aircraft, further evaluation may be required by a Flight Inspector, acting as an observer on board an appropriately equipped aircraft flying the procedure.

(2) Procedural Review. The Flight Inspector prepares charts, obtains receiver TD calibration values, and approach waypoint information. Review the GDOP, predicted SNR values, and LSES evaluations. Coordination between the AVN Data Analysis Branch and the Flight Inspector is essential.

c. Loran C:

(1) Facilities Maintenance Personnel shall conduct an LSES evaluation of the Loran C signals at the approach site before the commissioning flight inspection. This evaluation will establish the TD correlation between the LAM and the site. Any abnormal signals or out-of-tolerance conditions observed on the LSES disqualifies the approach site.

(2) Flight Personnel. The flight inspector prepares charts, obtains receiver TD calibration values, and approach waypoint information. Review the GDOP, predicted SNR values, and LSES evaluations. Coordination between the AVN Data Analysis Branch and the flight inspector is essential.

209.3 FLIGHT INSPECTION PROCEDURES. The flight inspection of RNAV procedures will evaluate the soundness of the procedure.

209.31 Checklist.

Type Check	Reference Paragraph	C	P
Transition/Feeder Route Segment	209.32	X	
Initial/Intermediate Approach Segment	209.32	X	
Final Approach Segment	209.32	X	X
Missed Approach Segment	209.32	X	
Bracketing Segment	209.32	X	
SIAP	209.32	X	X
Spectrum Analysis		X	X

209.32 Detailed Procedures.

a. Purpose. To evaluate the waypoint data accuracy and position determination throughout the area comprising the SIAP procedure. The Initial Approach Segment (IAS) begins at the IAWP and ends at the IWP. The Intermediate Segment begins at the IWP and ends at the FAWP. These points may be defined by the same coordinates in some procedure designs. The Final Approach Segment (FAS) begins at the FAWP and ends at the MAWP. The Missed Approach Segment (MAS) begins at the MAWP and may include turning or holding waypoints (MATWP or MAHWP) or fixes from ground-based navigation aids.

b. Equipment Configuration. Do not deselect any sensors. Verify that a current navigation database is installed.

c. Commissioning. The SIAP shall be entered into the RNAV navigation system. It may be on a supplied database, downloaded from a computer disk, or entered manually. Waypoints may be entered by latitude/longitude if not in the database.

d. Periodic. The SIAP must be loaded from the navigation system database, or the commissioning procedure in (c) above must be used.

e. RNAV, FMS, or GPS Detailed Procedures.

(1) Commissioning. The SIAP shall be entered into the FMS or GPS. When defining the approach, use “TRACK to FIX” between transition/feeder waypoints, unless otherwise specified in the procedure. Enter waypoint altitudes as depicted. Do not use any “WHEN AUTHORIZED BY ATC” altitudes. The end-of-approach waypoint altitude at the threshold should be the actual threshold MSL altitude, plus the proposed Threshold Crossing Height (TCH). The FPA will be computed from the FAWP altitude to the end-of-approach waypoint altitude by the FMS. If a FPA is entered, based on the end-of-approach waypoint altitude, a FAWP altitude will be computed by the FMS.

(2) Periodic. The SIAP must be loaded from the FMS or GPS database, or the commissioning procedure must be used.

(3) Procedure Design. Verify that **true** bearings to next waypoint, distances, and the FPA indicated on the FMS or GPS match the procedure. Out-of-tolerance values must be resolved with the procedures designer. RNAV-equipped aircraft perform a particular procedure based on coded information in the navigation database. This coded information includes type of waypoint (Fly-Over or Fly-By), ARINC 424 leg type, and speed-altitude restriction. A difference in the coded data from the original procedure design can result in very different RNAV performance. The Flight Inspector shall verify that the flight plan, as derived from the database, matches the procedural design.

(4) FMS or GPS Procedure Inspection. Approach safety and flyability shall be evaluated.

The LNAV/VNAV procedure and the LNAV procedure are designed with different obstruction criteria. The final segment of the approach (FAWP to MAWP) may have different obstructions controlling the VNAV Decision Altitude (DA) and LNAV Minimum Descent Altitude (MDA). The final segment may require repeated flights for obstacle evaluation. Obstacle evaluation for RNP procedures may require flying linear offsets from the intended course.

Evaluate the glidepath throughout the FAS from the FAWP to the DA or Missed Approach Waypoint. Guidance is provided by satellite or Flight Management System LNAV navigation with computed positive vertical guidance based on barometric, satellite, or other approved VNAV systems.

(5) For LNAV/VNAV, the aircraft should be flown with the auto-pilot coupled to the RNAV system to evaluate transition to final segment vertical guidance.

(6) Verify that all course and distance information provided by the RNAV system agrees with the procedural information/charts for the procedure. The procedure course must be displayed on the EFIS during the inspection. The procedure depicted on the EFIS shall agree with the chart.

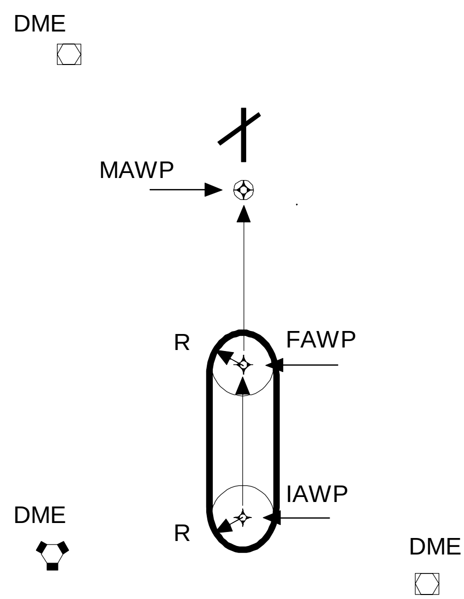
(7) Verify any designated runway update reference points that are to be used by an aircraft before initiating an RNAV Departure Procedure. Perform an IRU down mode alignment or fix update at a known geographic point before takeoff.

(8) Monitor any announced quality factors (RNP/ANP or "Q-factor") of the navigation system sensors throughout the procedure. Note any degradation of system position accuracy that may affect the track flown.

(9) Waypoints:

(a) DME Supporting RNAV Vertical Navigation (VNAV) Waypoints. Evaluate individually the TERPS-specified DME's used for VNAV RNAV updating at an individual waypoint by checking for coverage in an orbit centered on the waypoint coordinates. The radius of the orbit shall be calculated based on the DME station farthest from the waypoint, using the formula contained in Chapter 302, or 3.0 nm, whichever is larger. For those procedures where coverage needs to be defined for an approach segment defined by two waypoints (IWP to FAWP), the DME's shall be evaluated by flying a racetrack (holding) pattern as indicated in Figure 209-1. The radius of the turns shall be as determined for single waypoints. DME coverage previously evaluated and found satisfactory at or below the waypoint procedural altitudes need not be re-evaluated.

Figure 209-1



Determine coverage from each DME in the area outlined by a solid line.

(b) Periodic Inspections. If the procedure is contained in the navigation system database, it shall be used for periodic inspections. If the navigation system database has the waypoints used to define the RNAV procedure, the waypoints shall be individually loaded into the FMS or GPS flight plan from the database.

(10) Positioning:

(a) Initial and Intermediate Segment evaluation may be performed when flying by the waypoint if depicted as such on the procedure.

(b) Initial and Intermediate Segments shall be flown at procedural altitudes.

(c) The FAS positioning shall be such that all waypoints depicted in a straight line are evaluated by flying over the waypoint and evaluating GPS positioning determination and delivery alignment. Position the aircraft to fly from at least two miles outside the first waypoint in a straight line (normally an IWP or FAWP) and overfly all waypoints to the MAWP. Final approach segments shall be flown from the FAWP to 100 ft. below the lowest published MDA at the MAWP.

(11) Airspeed, Altitude and Track:

(a) If more than one airspeed is depicted for the procedure, the Flight Inspector shall determine which airspeed will be utilized for the inspection. Multiple runs at various airspeeds may be required if the Flight Inspector, the procedure designer, or Air Traffic Control (ATC) deem it necessary.

(b) Fly the procedure at the minimum altitudes specified.

(c) The automatic leg change mode shall be used for the procedure.

(d) An approach will be flown to the MAWP, as published, and through the entire MAP.

(12) RNAV Departure Procedure (DP). A RNAV DP may be flown from an actual takeoff or from a low approach. If the low approach method is used, cross the runway threshold at 50 ft and verify navigation system accuracy by noting ANP and/or performing a fix update over the threshold. The departure procedure will be flown to the point or fix at which the en route phase begins.

(13) Standard Terminal Arrival Route (STAR). A STAR may require validation. Vertical navigation may be required. Descent gradients, leg lengths, and human factors involving use of FMS operations require evaluation. When altitude and/or airspeed constraints are shown on the procedure, fly the procedure at the specified altitudes/speeds. If an altitude window is specified, fly the procedure using altitudes within the constraints that provide the steepest descent path, as well as flying the procedure using minimum altitudes. The arrival procedure shall be flown through transition to an instrument approach procedure, if required.

(14) Routes. Fly routes at minimum procedural altitude. Program waypoints as “fly-by” unless otherwise designated.

(15) Evaluation. Prior to the procedure being flown, the flight plan data shall be compared to the procedural data to ensure bearings and distances between waypoints reflect the procedure design. Minor differences are normal and may be due to internal rounding by the FMS or GPS receiver. Evaluate obstacles, positioning data, and signal anomalies that may be caused by interference.

c. Loran-C. Use the CHAIN and dedicated TRIAD stations on the approach procedure. When marginal or out-of-tolerance conditions are discovered, the use of other stations may be investigated. Cycle slip disqualifies a procedure (see paragraph 209.42)

(1) Flight inspection of Loran-C approaches and the supporting signals is conducted using tracks between waypoints. The following actions are required during the approach evaluations.

(a) Select the correct CHAIN and dedicated TRIAD stations.

(b) Use the procedural waypoint coordinates.

(c) Use the published TD calibration values.

(d) Select the approach mode while flying the track maneuvers.

(e) Monitor signals throughout the approach. Record position coordinates and signal parameters at each waypoint and whenever tolerances are exceeded.

(f) Record XTK and AFIS information during all maneuvers.

(2) Transition/Feeder Route Segment:

(a) This segment provides a transition route from a navigational aid or fix to the IAF.

(b) Segments may be flown in either direction between the feeder fix and the IAF.

(c) Evaluate for cycle slip and SNR. Record XTK (and all error traces when using AFIS) during the entire segment. Record the position coordinates at each waypoint and evaluate for accuracy when using AFIS.

(3) Initial/ Intermediate Approach Segments:

(a) These segments provide a transition route from the IAF and IF to the FAF.

(b) Segments may be flown in either direction between the IAF and the FAF.

(c) Evaluate for cycle slip and SNR. Record XTK (and all error traces when using AFIS) during the entire segment. Record the position coordinates at each waypoint and evaluate for accuracy when using AFIS. Verify controlling obstructions.

(4) Final Approach Segment:

(a) This segment is the route from the FAF to the MAP.

(b) This segment is flown from the FAF to 100 ft. below the lowest published MDA at the MAP. Check the accuracy of the MAP or AER on the ground.

(c) Prior to the MAP, visually confirm that the course between the two waypoints coincides with the intended final approach course. Evaluate for cycle slip and SNR. Record XTK (and all error traces when using AFIS) during the entire segment. Evaluate the MAP waypoint for accuracy. When the MAP waypoint occurs at a point other than the AER, the AER may be used for the accuracy check. Airborne evaluations are acceptable. During this segment, inteference is more likely to be encountered. Evaluate suspected electromagnetic interference with the spectrum analyzer. Verify the controlling obstructions.

(5) Missed Approach Segment:

(a) This segment provides a transition route from the MAP to a waypoint for another approach or to join the en route structure.

(b) The missed approach procedure is flown from the MAP.

(c) Evaluate for cycle slip and SNR. Record XTK (and all error traces when using AFIS) during the entire segment. Record the position coordinates at each waypoint and evaluate for accuracy when using AFIS. Verify controlling obstructions.

(6) Bracketing Segment:

(a) The inspection ensures usable signals are available at .5 nm each side of the final approach course.

(b) Segments shall be flown in either direction between the FAF and the MAP at the minimum descent altitude.

___________________ BRACKETING SEGMENT
.5 nm
FAF__________MAP
.5 nm
___________________ BRACKETING SEGMENT

(c) Evaluate for cycle slip and SNR. Record XTK (and all error traces when using AFIS) during the entire segment.

209.4 FLIGHT INSPECTION ANALYSIS

a. Flight inspection of RNAV procedures determines if the procedure is flyable and safe. If a new procedure is unsatisfactory, the Flight Inspector shall coordinate with the procedures designer, ATC, and/or the proponent of the procedure, as applicable, to determine the necessary changes. When existing procedures are found unsatisfactory, notify the procedures designer immediately for Notice to Airman (NOTAM) action. The inspector shall evaluate the following items:

(1) The controlling obstacles are verified.

(2) SIAP. The procedure is technically sound. Human factors, including situational awareness, complexity, interpretability, cockpit workload, pilot error, auto-pilot operations, and memory considerations, are considered. Consider the types of aircraft that will be using the procedure during the evaluation.

(3) Waypoint spacing is sufficient to allow the aircraft to stabilize on each leg segment without jumping over waypoints/legs. Leg length is sufficient where aircraft deceleration may be required.

(4) The RNAV procedure will satisfactorily deliver the aircraft to an established point which terminates the procedure (en route fix, IAF, MAWP, decision altitude, etc.)

(5) Procedural Design. The procedure shall be evaluated to verify the geodetic coordinates (waypoints) and vertical path angles meet the requirements of Paragraph 209.5.

(6) Communications, navigation system performance, and RADAR coverage, if required, is adequate for the entire procedure.

(7) Surveillance inspection of airport lighting, runway/taxiway markings, IRU/runway update reference points, etc., will be accomplished during the flight inspection of the procedure.

(8) FMS and GPS Parameters. The following parameters shall be documented at the time abnormalities are found during any phase of the flight inspection.

Parameter	Expected Value
HDOP	1.0 - 4.0
VDOP	1.0 – 4.0
HFOM	Less than 100 meters
Satellites in view (PRN)	5 minimum
SNR	30 dB/Hz minimum
DME (supported waypoint)	Minimum –80dbm

There are no flight inspection tolerances applied to these parameters. However, the values listed above provide a baseline for analysis of any GPS signal anomalies or interference encountered.

(9) Electromagnetic Spectrum. The RF spectrum from 1200 to 1250 MHz and 1555 to 1595 MHz should be observed when GPS parameters indicate possible RF interference. Interfering signals are not restrictive, unless they affect the receiver/sensor performance. The SNR values being recorded may indicate RF interference problems. The normal GPS signal strength is –130 to –123 dBm. Use the SNR values, along with the spectrum analyzer, to investigate the RF interference, the location of its occurrence, and possible sources. Particular attention shall be given to harmonics on or within 20 MHz of GPS L1 (1575.42 MHz) and those on or within 10 MHz of GPS L2 (1227.6 MHz). Report any spectrum anomalies or suspected anomalies encountered to the National Maintenance Control Center (NMCC).

b. Loran-C.

(1) Course Structure is the excursion characteristic of the Loran-C receiver cross-pointer, which includes bends, roughness, and other aberrations. The computed course information shall not exhibit irregular or erratic course structure. Excursions of the course are caused by errors in the transmitted signal, avionics equipment, and in areas having poor GDOP. Analyze real time XTK error trace for excursions from zero reference line. Deviations exceeding 0.3 nm should be evaluated. Analyze corrected error trace for position accuracy.

(2) Cycle Slip. Normally a receiver will track the third cycle of the pulsed 100 kHz carrier for time measurements. When cycle slip occurs, the receiver tracks the wrong cycle. Each cycle slip results in a 10-microsecond error and a corresponding error in navigation accuracy. Cycle slip can be caused by large ECD, low SNR values, RF interference, and unusual RF signal propagation. Cycle slip is more likely to occur when a receiver first acquires a new combination of signals.

Envelope-to-Cycle Discrepancy (ECD) is the difference between the desired actual zero phase crossing of the third cycle. It is affected by RF signal propagation, SNR, interference, etc. ECD values exceeding –2.4 to +3.5 microseconds may cause cycle slip. When ECD values exceed the range of –2.4 to +3.5 microseconds, ensure the position accuracy and course structure meet tolerances.

Compare the received latitude and longitude positions to a known geographic position or use an AFIS. A difference greater than 1.0 nm may indicate cycle slip. If cycle slip occurs, the SIAP shall be disapproved.

(3) Electromagnetic Spectrum. The RF spectrum from 90 to 110 kHz should be observed for RF interference. Interfering signals shall not affect accuracy. Electrical power lines, factories, and RF transmitters are potential sources of interference. Electrical power lines (with RF signals), within ± 1,200 ft of the final approach segment, may affect receiver performance. If interference is suspected, use the spectrum analyzer to identify the source. If unable to eliminate interference, disapprove the procedure.

(4) Position Accuracy. The position accuracy is the difference between the receiver position (using TD calibration values) and the correct geographic position. System accuracies are improved by seasonal receiver TD calibration values. Verify that the correct CHAIN, dedicated TRIAD, and TD calibration values are inserted in the receiver. Analyze position accuracy by using the AFIS or visual checkpoints.

(5) Signal-to-Noise Ratio (SNR) is a ratio of signal strength versus receiver noise. It may affect position accuracy. Loran-C signals may be affected by atmospheric noise, aircraft static charges, power line signals, etc. Low values may cause cycle slip. Two methods of measuring receiver SNR's are SNR-FS and SNR-PH. Monitor and record all SNR values. CALIBRATED SNR values should be used.

209.5 TOLERANCES

Parameter	Ref. Para.	Tolerance/ Limit
Procedure Design		
Routes **True Bearing** to next WP Distance to next WP	209.4	± 1° ± 0.1 nm
Initial/Intermediate Approach Segment **True Bearing** to next WP Distance to next WP	209.4	± 1° ± 0.1 nm
Final Approach Segment **True Bearing to next WP** Distance to next WP	209.4	± 1° ± 0.1 nm
Missed Approach Segment **True Bearing to next WP** Distance to next WP	209.4	± 1° ± 0.1 nm
Vertical Path	209.32	± 0.1°
FMS/GPS		
Satellites Tracked		RAIM
DME-Supported Waypoint	209.32	Lock-On
Loran-C		
Course Structure	209.4	Within ± 0.3 nm of the desired track during all approach segments.
Cycle Slip	209.4	None allowed
Electromagnetic Spectrum	209.4	Interference shall not affect receiver performance or accuracy
Position Accuracy	209.4	Within ± 0.3 nm
Signal-to-Noise Ratio	209.4	+3 dB or greater

209.6 ADJUSTMENTS. Reserved.

SECTION 210

RESERVED

SECTION 211. COMMUNICATIONS

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SECTION 211. COMMUNICATIONS

211.1 INTRODUCTION. Air/ground communications services within the NAS are classified according to function. En route communications (ECOM) is the service provided between ARTCC controllers and pilots, and includes RCAG and BUEC facilities. Terminal communications (TCOM) is the service provided between approach and departure controllers and pilots in terminal airspace, including RCF and ATCT facilities. FSS communications (FCOM) is the service provided between FSS and pilot and are advisory in nature, such as EFAS. Other advisory services include ATIS, AWOS, and ASOS, all of which may be transmitted on a NAVAID or a discrete communications frequency.

211.2 Preflight Requirements. The flight inspector shall prepare for the flight inspection in accordance with the procedures outlined in Section 106. Coverage requirements, including tailored sector definitions, shall be provided by local facility maintenance and air traffic personnel.

211.3 Flight Inspection Procedures. The performance of communications facilities is accurately predicted by computer aided modeling. Therefore, commissioning inspections are only required when requested by facilities maintenance engineering. Periodic inspections shall be conducted on a surveillance basis in conjunction with evaluation of associated navigation and air traffic control facilities.

211.31 Checklist.

Type Check	Reference Paragraph	C	P
TCOM	211.32011	1	2
ECOM	211.32012	1	2
ATIS	211.32013	1, 3	2, 3
AWOS/ASOS	211.32014	1, 3	2, 3
TWEB	211.32015	1, 3	2, 3

FOOTNOTES:

1. When requested.
2. Surveillance inspections conducted during other inspection evaluations.
3. If the NAVAID has no other voice services, verify that the voice broadcast effect on the navigation signal is within applicable tolerances.

211.32 Detailed Procedures.

211.3201 Coverage. When coverage cannot be predicted by facility engineering, a flight inspection will be requested. Evaluate facilities where the minimum en route altitude (MEA) is determined by communications coverage.

a. During requested commissioning inspections, coverage shall be determined by the air traffic service requirements established locally.

b. Flight profiles may vary according to the local requirements and could include an orbit or a detailed sector evaluation. Communications for fixes, hand-off positions, changeover points, or controlled airspace shall be checked.

c. Additional frequencies assigned to the same service requirement will not require a complete inspection, but should be evaluated on a surveillance basis.

d. Light Gun Signals shall be checked for adequate coverage on the ground and in flight.

e. Standby equipment shall be checked during any requested commissioning inspection.

211.32011 Terminal Communications (TCOM) includes tower, ground control, clearance delivery, departure, arrival, and light gun communications. Commissioning inspections, when requested, shall be conducted at the extremities of the airport to determine if there are blind spots and adequate coverage. Departure and arrival frequencies shall be checked to verify service throughout the established sector volume.

211.32012 En route Communications (ECOM) includes VHF and UHF air/ground frequencies and BUEC channels. When requested, these frequencies shall be evaluated throughout the established sector service volume.

211.32013 Automatic Terminal Information Service (ATIS) broadcast on a NAVAID facility shall be commissioned and reported with that NAVAID (see Section 201). When commissioning is requested, ATIS broadcast on a discrete communications frequency shall be checked in accordance with local requirements. Departure ATIS shall be verified at the airport extremities.

211.32014 Automated Weather Observing System (AWOS)/Automated Surface Aviation Observing System (ASOS). These systems provide local weather observations and may be broadcast on a NAVAID or a discrete VHF communications frequency. Transmission on a NAVAID shall be verified in accordance with Section 201 or 207. Local altimeter settings from these systems can result in lower minimums for standard instrument approach procedures. Whenever this occurs, ensure that the associated procedure has been flight inspected to the new minimum prior to publication. When AWOS/ASOS is used as the primary airport altimeter source, flight inspection shall verify reception at or before the initial approach fix (IAF).

211.32015. Transcribed Weather Broadcast (TWEB). This system broadcasts route-oriented data with specially prepared National Weather Service forecasts, inflight advisories, and winds aloft plus pre-selected current information, such as routine or special weather reports (METAR/SPECI), NOTAM's, and special notices. The data is broadcast continuously over selected L/MF and H NDB's and/or VOR's.

211.4 Analysis. Unsatisfactory conditions shall be brought to the attention of the appropriate air traffic control and facilities maintenance personnel.

211.5 Tolerances.

a. Maximum Recommended Coverage. Communications frequencies are engineered for distinct volumes of airspace which are guaranteed to be free from a preset level of interference from an undesired source. Each specific function has its own frequency protected service volume. Some are cylinders and others are odd multi-point geometric shapes. These odd shapes are normally required for en route ATC services. Following is a table of maximum altitude and radius dimensions recommended for each type of service. Under no circumstance will a service volume be approved at an altitude and distance greater than the radio line of sight (RLOS) distance (reference Figure 303-1).

	Maximum Dimensions	
Service	**Altitude**	**Distance**
ECOM		
Low Altitude	surface to 23,000	60
Intermediate Altitude	11,000 to 25,000	60
High Altitude	24,000 to 35,000	150
Ultra-High Altitude	35,000 and above	150
TCOM		
Ground Control	100	5
Clearance Delivery	100	5
PAR (Military)	5,000	15
Helicopter	5,000	30
Local Control	25,000	30
Approach Control	25,000	60
Departure Control	25,000	60
ATIS		
Arrival	25,000	60
Departure	100	5
AWOS/ASOS	10,000	25
NAVAID	Section 201 or 207	
Discrete Comm	At or before the IAF	
TWEB	Section 201 or 207	

b. Local Requirements. Communications service volume requirements are established by the controlling Air Traffic facility based on local operational requirements. When a flight inspection is requested, these local requirements shall be validated and adjusted, if necessary, for satisfactory operation. Communications shall be clear and readable.

c. Restrictions. USAF air traffic control facilities will not be restricted due to unusable radios unless the ability to provide required service is severely limited; the loss of 50% or more of published frequencies or loss of VHF/UHF emergency capability is considered a severe limitation. Document inoperative or unusable radios and frequencies on the flight inspection report. The inoperative or unusable radio or frequency can be returned to service after a satisfactory operational check is conducted by local aircraft at a distance of maximum intended use and altitude of MVA/MEA.

d. Light Gun Requirements.

(1) Ground. Ensure adequate coverage for operational control of ground traffic.

(2) Air. Three miles in all quadrants at the lowest traffic pattern altitude.

211.6 Adjustments. All requests for facility adjustments shall be specific. Flight inspection certification shall be based on facility performance after all adjustments are completed.

SECTION 212. DIRECTION FINDING STATIONS (DF)

SECTION 212. DIRECTION FINDING STATIONS (DF)

212.1 Introduction. Direction finding stations use normal VHF or UHF communication transmissions from aircraft to determine bearing information from a ground station. Facilities maintenance personnel may then relay this information to an aircraft in flight to assist in determining the aircraft position. Doppler type VHF/DF is the standard equipment within the FAA. Older equipment, such as U.S. Navy VHF and UHF/DF facilities, may still be in use at certain locations. Operational performance and flight inspection procedures are the same for all DF equipment, with minor tolerance differences as noted in paragraph 212.5. AFIS is the accuracy standard, but non-AFIS equipped aircraft with suitable communication equipment may perform DF inspections when operated in accordance with appropriate sections in this manual. Direction Finding stations are normally located at or near airports and/or Flight Service Stations. Many DF facilities have the capability of providing an emergency instrument approach procedure where favorably sited with respect to an airport. Assuring the accuracy of these procedures is an integral part of the DF flight inspection.

212.2 Preflight Requirements

212.21 Facilities maintenance personnel shall prepare for flight inspection in accordance with procedures specified in Section 106. For commissioning inspections, facilities maintenance personnel should:

a. Prepare a detailed outline of any special information or procedure(s) desired as an outcome of the flight inspection;

b. Prepare the desired sequence for the inspection;

c. Optimize the facilities equipment.

d. Ascertain that fully qualified operators and maintenance technicians are available.

212.22 Flight Personnel shall prepare for the DF flight inspection in accordance with procedures specified in Section 106. Air crews shall:

a. For commissioning inspections, prepare a chart with the DF facility accurately plotted and appropriate radials and a 360 ^{o} orbit drawn. The scale of the chart should be 1:500,000 (Sectional) or larger and the areas to be overflown evaluated per Section 214.

b. Obtain information from facilities maintenance personnel pertinent to the planned inspection, including desired outcomes, expected performance, and sequence of events.

c. For periodic inspections, obtain previous flight inspection data pertinent to the planned inspection.

212.3 Flight Inspection Procedures. The aircraft must be positioned precisely to determine bearing accuracy and service area. AFIS has the positioning capability to the accuracy standard required. Non-AFIS aircraft may perform the inspection if accurately plotted ground check points are selected and the aircraft can be safely maneuvered over these checkpoints. Where neither AFIS nor ground check point positioning is available, the theodolite shall be used. The DF operator will be briefed to compute all bearings as from the DF facility except for station passage and approach procedures.

212.31 Checklist. All of the checks listed below shall be performed on the commissioning flight inspection. Special flight inspections may require any one or all of these checks, depending on the reason for the inspection. Periodic inspection of bearing accuracy will be conducted in conformance with paragraph 212.32025.

Type of Check	Reference Paragraph	C	P
Preliminary Station Alignment	212.3201	X	
Bearing Accuracy	212.3202	X	X
Alignment Orbit	212.32021	X	
Communication and Coverage	212.3203	X	X
Station Passage	212.3204	X	
Operator Performance	212.3205	X	
Standby Power	212.3206	X	
DF Approaches	212.3207	X	

212.32 Detailed Procedures.

212.3201 Preliminary Station Alignment.

a. Use AFIS and select an azimuth from the DF facility to establish an alignment reference. For non-AFIS aircraft, use the theodolite on a pre-determined azimuth or select a checkpoint which lies within the quadrant of the planned orbit containing the maximum number of checkpoints. At an altitude which will assure radio line of sight, obtain a DF bearing from the operator and compare this bearing with the actual bearing determined from AFIS, theodolite, or checkpoint at the beginning of the transmission to the DF facility.

b. If the DF bearing error is less than $\pm 6^{o}$, continue an orbital flight for at least 90^{o} of azimuth. Non-AFIS aircraft will orbit in the direction of the maximum number of checkpoints; theodolite or AFIS orbit direction is at the discretion of the flight inspector and/or DF operator. If the remaining bearings in this primary quadrant are within $\pm 6^{o}$, proceed with the bearing accuracy check as required in paragraph 212.3202. If the reference or succeeding DF bearings in this primary quadrant exceed $\pm 6^{o}$ error, the equipment shall be adjusted and the procedure repeated. From the preliminary check, data should be derived to balance the overall error curve.

212.3202 Bearing Accuracy.

a. DF coverage will not substantially exceed line-of-sight. Coverage is dependent on power output, antenna height, terrain, and the effects of signal reflection. The bearing accuracy check is conducted to determine the ability of the DF facility to furnish accurate bearings throughout the service area during commissioning, and forms the reference for other inspections. This is done by comparing DF bearings from the facility with bearings measured from AFIS, theodolite, or ground checkpoints.

b. If communications become unsatisfactory, or if bearing errors exceed tolerance, climb above the altitude being flown until adequate communications are established again and/or bearing errors are satisfactory.

c. If communications and bearing accuracy remain satisfactory on the next measurement, descend to the appropriate selected altitude or to the minimum altitude which will provide satisfactory bearings and communications, whichever is higher, and continue to the next checkpoint. This procedure will provide the lowest altitudes throughout the coverage area of the DF facility at which acceptable bearing information and communication can be expected.

212.32021 AFIS Alignment and Orbit.

a. Proceed to the range appropriate to the facility and to the altitude previously determined. If HYBRID Mode is not available, use the minimum DME update altitude and plan to fly a second orbit for coverage if the minimum DME update altitude is higher than the intended use altitude. The AFIS will be programmed for the DF facility parameters (Identification, Latitude, Longitude, Magnetic Variation) inserted in the FI FAC series.

b. For initial facility alignment (reference), the AFIS system will be programmed for an RNAV Radial flight path, Inbound or Outbound, beyond 10 nm from the DF antenna. DF bearing accuracy may be determined by comparing the operator DF bearing to the bearing displayed on the CDU. RNAV/Autopilot coupled flight is recommended for Radial or Orbit maneuvers.

c. After the initial alignment has been accomplished, an Orbit CW or CCW will be programmed and flown. An event mark will be made on the recording at the position the transmitter is keyed for the DF steer; comparison can then be made to the 5^{o} bearing marks on the analog recording.

212.32022 Theodolite Orbit.

a. The theodolite shall be aligned to read magnetic bearings from the DF station. It should be located adjacent to the DF site at a position where the aircraft will be visible throughout as much of the orbit as possible. This position should be less than 300 ft from the site. The flight inspector should brief the DF operator and the theodolite operator to avoid confusion during the actual flight inspection.

b. The theodolite operator shall track the aircraft throughout the orbit and actuate one event mark (1020 Hz tone) at each 10 degrees of azimuth. The pilot shall transmit for a DF bearing at frequent intervals and actuate the pilot event mark on the opposite side of the recording during each such transmission. The airborne technician shall label each of these event marks. The leading edge of the theodolite event mark will represent the actual bearing of the aircraft from the station, and the pilot event marks will represent the DF bearing. The airborne technician will label the DF bearing as reported by the DF operator and determine the error with the use of proportional ("Ten Point") dividers.

212.32023 Checkpoint Orbit

a. Position the aircraft over the predetermined checkpoints. Where possible, these checkpoints should be located at or near the limits of the DF and communication range capability to validate bearing accuracy and service area simultaneously. As the aircraft approaches the first ground checkpoint or measured bearing, the pilot shall transmit a 10-second radio signal, timed so that the aircraft will be over the checkpoint in the middle of the transmission. Compare the bearing provided by the DF operator with the measured magnetic bearing. Note each DF bearing, magnetic bearing, error, radio frequency, altitude, and distance on the flight inspection report. Bearing errors shall be computed in the same manner as VOR course alignment errors; i.e., when the aircraft bearing is less than the bearing reported by the DF operator, the error is negative.

b. Proceed with the orbit of the facility at the appropriate range and altitudes, obtaining bearings as often as practical. After initial contact has been established, a 5 to 10 second radio signal is usually sufficient to obtain bearings. Because of the capability of almost instantaneous readout on the Doppler type DF, a five-second radio signal is usually sufficient to obtain bearings on this type facility.

212.32024 Analysis of Bearing Accuracy. After completing the bearing accuracy check, station adjustment may be necessary to balance station error and keep all bearings within tolerance. Whenever bearing errors are very large in a particular area and normal elsewhere, it may be advisable to investigate the area further by checking radially or by partial orbits at different ranges. When an out-of-tolerance condition cannot be corrected, the controller shall be advised of the area(s) which are not to be used. The condition(s) will be noted on the flight inspection report and the facility assigned a "restricted" classification. A NOTAM will not be issued.

212.32025 Periodic Inspections will include a bearing accuracy check at a minimum distance of 20 nm and at a minimum altitude of 1500 ft, an altitude which will provide obstacle clearance in the area, or radio line of sight, whichever is highest. A minimum of one bearing check shall be accomplished on each published frequency and, if available, the VHF emergency frequency.

212.32026 Commissioning Inspection

a. An orbit procedure, as outlined in paragraph 212.32, shall be used to evaluate bearing accuracy for the commissioning flight inspection. Orbit radius shall be the minimum of:

(1) 40 miles for Doppler DF facilities;
(2) 30 miles for older equipment;
(3) operational requirements

The altitude shall be 1500 ft above site elevation, or the minimum altitude which will provide 1,000 ft of obstacle clearance (2,000 ft obstacle clearance in designated mountainous areas), or the minimum altitude which will provide radio line-of-sight, whichever is the higher.

b. AFIS or theodolite bearings may be taken at frequent intervals as close together as 10^o. A minimum of four bearings shall be taken for each quadrant, regardless of which orbit method is used.

212.3203 Communications and Coverage. Voice communication is the means for getting DF information to a pilot. Quality of communications greatly affects the capability of the DF to provide quality service. Bearings shall be obtained on as many of the published frequencies as practical during the checkpoint orbit. For a commissioning inspection, all frequencies proposed for use will be checked. This may be accomplished on the orbit or during radial flight at the extremes of coverage. For periodic inspections, voice communications will be checked on all frequencies if less than four are used for DF bearings. If more than four are available, at least four frequencies will be checked. The VHF emergency frequency, if available, shall be evaluated during all flight inspections. Where coverage is required at greater distances for special purposes, it can be determined by either orbital or radial flight at the greater distance and altitude.

212.3204 Station Passage. Fly inbound to the DF antenna from a position at least 5 miles out and an altitude of 1500 ft above the antenna. Obtain sufficient steers from the DF operator to overfly the antenna and note the distance from the aircraft to the DF antenna when the operator reports station passage. This check may be performed in conjunction with the DF approach procedure (Paragraph 212.3207) at the discretion of the pilot and DF operator.

212.3205 Operator Performance. The flight inspector must determine that the overall system is safe and reliable. The operator should be able to direct the aircraft over the facility, report station passage, and provide pertinent information relative to the use of DF service. If an emergency approach procedure has been established (DF approaches are not SIAPs), the operator should be able to direct the aircraft to a position from which a safe landing can be made.

212.3206 Standby Power.

a. Standby power, if installed, shall be checked on the commissioning inspection to ensure that no derogation of communication or bearing accuracy occurs when using the alternate power source. An orbit on each source will be performed and the bearing accuracy and overall station error compared. If standby power is installed at a later date, the facility will be inspected on standby power at the first periodic inspection scheduled after the installation of the standby power system. Inspections after a change in the standby power source are at the discretion of the Airway Facilities Engineering Division.

b. Periodic inspections normally will not require the use of standby power systems. Airway Facilities personnel may request a check on standby power if they suspect that the alternate power source causes a deterioration in the performance of the DF facility.

212.3207 DF Approaches.

a. The emergency DF approach shall be checked at the time of commissioning. Airway Facilities personnel or DF facility operators may request a check of the approach during any inspection if, in their opinion, verification of the procedure, obstructions, or equipment performance is desired.

b. Conduct the approach in accordance with the DF operator's instructions and evaluate the obstacle clearance and flyability per Section 214. The flight inspector shall note the position of the aircraft relative to the airport and determine whether it will permit a safe landing.

212.4 Standby Equipment. Where installed, standby equipment will meet the same operational tolerances during commissioning as the primary equipment. Periodic inspection of standby equipment is not required unless requested by Airway Facilities, Engineering, or the DF operator.

212.5 Tolerances. All DF stations shall conform to these tolerances for an UNRESTRICTED classification. Classification of the facility is the responsibility of the flight inspector.

a. Bearing Accuracy

VHF/DF, UHF/DF: Each DF bearing must be within 10^{o} of the actual bearing.
VHF/DF (doppler): Each DF bearing must be within 6^{o} of the actual bearing

b. Coverage

VHF/DF UHF/DF: 30 miles
VHF/DF (doppler): 40 miles

c. Communications. Communications on all required frequencies shall be clear and readable throughout the coverage area.

d. Station Passage. Station passage must be recognized within 1 1/2 miles at 1500 ft AGL.

e. Controller Performance. Controllers shall be capable of directing an aircraft to the station, reporting station passage, providing guidance for an emergency approach, and vectoring aircraft to avoid terrain and obstacles.

f. Standby Power. The DF facility will meet all tolerances in this section when operating on an alternate power source.

g. Emergency Approaches. Where a DF approach procedure is established, the system shall provide the capability of directing the aircraft to a position from which a safe landing can be made.

212.6 Adjustments. Equipment adjustment shall be made to balance the overall station error.

SECTION 213

RESERVED

SECTION 214. FLIGHT INSPECTION OF INSTRUMENT FLIGHT PROCEDURES

TABLE OF CONTENTS

Paragraphs *Title* *Pages*

SECTION 214. FLIGHT INSPECTION OF INSTRUMENT FLIGHT PROCEDURES

214.1 INTRODUCTION. Instrument flight procedures specify standard routings, maneuvering areas, flight altitudes, and visibility minimums for instrument flight rules (IFR). These procedures include airways, jet routes, off-airway routes, standard instrument approach procedures (SIAP), standard instrument departure procedures/departure procedures (SIDs/DPs), and standard terminal arrival routes (STARs). All new and revised procedures are subject to flight inspection.

214.2 PREFLIGHT REQUIREMENTS

a. The office initiating the procedure shall forward all data necessary for conducting the flight inspection to the Flight Inspection Central Office (FICO) who in turn will forward the information to the flight inspector responsible for the inspection. If there are special factors relative to the procedure, the FICO shall set up a briefing by the procedures specialist, or designee, for the flight inspector.

b. Procedural data shall include the following as a minimum:

(1) Charts of sufficient detail to safely navigate and identify considerable terrain, obstacles, and obstructions;

(2) Identification of controlling terrain/ obstructions for each segment;

(3) Minimum (and maximum where applicable) altitudes determined to be usable from map study and data base information for each segment of the procedure;

(4) Narrative description of the procedure;

(5) Plan and profile views for SIAPs;

(6) Data for each fix, intersection, and holding pattern;

(7) Communication applicable to each segment of the procedure;

(8) Airport marking and any special local operational procedure (e.g., noise abatement, non-standard traffic patterns, lighting activation).

c. Current forms are acceptable from established organizations involved in the development of instrument procedures. If the procedures package as delivered to the FICO is inconsistent with this section, the package will be returned intact to the developing organization. If, after the package is sent to the flight inspector, it is found to be inconsistent with this section, the flight inspector shall return it intact to the FICO who shall return it to the developing organization. The FICO/flight inspector shall identify deficiencies on a comment sheet to accompany the returned procedures package.

d. Two copies of the procedure will be provided to the FICO.

214.3 FLIGHT INSPECTION PROCEDURES

a. The objective of evaluating instrument flight procedures is to ensure safety and flyability. The following items are included in this evaluation:

(1) Aircraft maneuvering is consistent with safe operating practices for the category of aircraft intending to use the procedure.

(2) Cockpit workload is acceptable.

(3) Navigation charts properly portray the procedure and are easily interpreted.

(4) Runway markings, lighting, and communications are adequate.

(5) The applicable system (NAVAID, Satellite, FMS, etc.) supports the procedure.

References in this section are for clarification purposes only and do not supersede instructions or flight inspection criteria for facilities or systems contained elsewhere in this order.

b. A restricted NAVAID may still support an instrument flight procedure when the procedure does not use the out-of-tolerance area. Those areas shall be reflected on the flight inspection report and on the navigation charts where performance will restrict or limit the expected procedure.

c. A distance measuring equipment (DME) arc segment may be used in areas of unusable radial information, provided that the DME, the radial where the arc starts, the lead radial, the final approach radial, and any other radial used in the procedure meet required tolerances.

d. The flight inspection of an instrument flight procedure and verification of the SIAP obstacle data may be conducted during the applicable system inspection if visual meteorological conditions (VMC) prevail throughout each segment of the procedure to be evaluated.

e. Verification of Obstacle Clearance

(1) Identification of New Obstacles. In most instances, accurate information concerning the location, description, and heights of tall towers and other considerable obstacles is available from the FAA data base and/or other government sources. When a new obstruction not identified in the procedures package is discovered and may become the controlling obstruction for the segment, the procedure commissioning will be denied until the procedure specialist can analyze the impact of the obstacle on the overall procedure.

(2) Obstacle Locations shall be noted in latitude/longitude as determined from a flight inspection receiver (e.g., GPS), or radial/bearing and distance from a known facility. If these methods are not available, an accurate description on the flight inspection map may be used.

(3) Estimation of Obstacle Heights.

(a) When a new obstacle not identified from current data base information is discovered, the flight inspector will ascertain, via the safest and most expeditious method available, the location and height of the new obstruction and forward the information to the procedure specialist listed on the request for flight inspection. Obstacle heights measured in flight will not be used unless the actual height of the obstruction cannot be determined by other means. If inflight height determination is required, accurate altimeter settings and altitude references must be used to obtain precise results.

(b) An alternative method for determining obstacle height is to select another obstacle in the near vicinity which has a known or published elevation. Fly abeam the uppermost point of the known obstacle and set the co-pilot's altimeter to read the same mean sea level (MSL) altitude as published. Without resetting the altimeter, fly abeam of the obstacle for which the height is unknown and note the altimeter reading. Where possible, note the AGL elevation for the procedure specialist and any deviation from the above procedure necessary to compensate for unlevel terrain.

(4) The flight inspection report will reflect the documentation for the method of height determination.

(5) Controlling obstacles in each approach segment shall be confirmed visually by inflight or ground observation. If unable to confirm that the declared controlling obstacle is the highest obstacle in the segment, list the location, type, and approximate elevation of the obstacles the flight inspector desires the procedure specialist to consider. The flight inspector will place special emphasis on discovered obstacles that may not be listed in the FAA data base. If the controlling obstacle is listed as terrain/trees or Adverse Assumption Obstacle (AAO), it is not necessary to verify which tree is controlling, only that no higher manmade obstacle is present in the protected airspace. If the flight inspector observes that the controlling obstacle has been eliminated or dismantled, the flight inspector shall forward that information to the procedures specialist.

(6) The controlling obstacle for initial approach segments of some RNAV procedures may also be the controlling obstacle for a large segment of the Terminal Arrival Area (TAA). The obstacle will not always be within the primary or secondary zones of the approach segment. Verify that there are no obstacles in the approach segments that are higher than the identified controlling obstacle. There is no requirement to verify that the identified controlling obstacle is the highest obstacle in the entire TAA segment, but, while transiting the segment, observe the area for obstacles that may exceed the height of the controlling obstacle. FAA Order 8260.3, TERPS, paragraph 1720 applies for TAA obstacle clearance.

(7) Conduct obstacle evaluations in visual meteorological conditions (VMC) only. The flight inspector retains the responsibility to ensure that the procedure is operationally safe and may use his/her discretion to vary the pattern to best suit the evaluation. If during a periodic inspection the procedure is flown at night, in IMC conditions, or the flight inspector cannot ascertain the required obstacle clearance (ROC), he/she shall state in the "Remarks" section of the flight inspection report that the obstacle verification was not accomplished and for which SIAP. If the obstacle verification cannot be accomplished either by other ground means or cannot be accomplished during the next periodic inspection, the procedure shall be notamed out of service until the check can be accomplished. During periodic inspections, it is not necessary to visually identify the controlling obstacle but rather to visually verify the integrity of the required obstacle clearance plane for the final and missed approach segment. For precision approaches with sloping obstacle clearance planes, only surveyed data should be used when considering obstructions.

f. GPWS Alerts. Some Ground Proximity Warning Systems (GPWS's) may alert while flying over irregular or rapidly rising terrain at altitudes providing standard obstacle clearance. If GPWS alerts are received while inspecting procedures, repeat the maneuver, ensuring flight at the designed true altitude. If the alert is repeatable, notify the procedures specialist.

214.31 Checklist.

Check	Ref. Para.	C	P
Final Approach Segment	214.3201	X	
	214.32011	X	X
Missed Approach Segment	214.32012	X	X
Circling Segment	214.32013	X	1
En route/Terminal Segments	214.3202	X	1
Fixes/Holding Pattern	214.3203	X	1
Air/Ground Communications	214.3204	X	1
Area Navigation/ GPS/FMS	214.3205	X	2

NOTE:

1. Surveillance.
2. SIAP's require periodic inspection per Section 105.

214.32 Detailed Procedures.

214.3201 Approach Segments. The requirements to evaluate signal quality are detailed in individual chapters. Requirements of this chapter are concerned with procedural aspects.

214.32011 Final Approach. The final approach course shall deliver the aircraft to the desired aiming point. The aiming point varies with the type of system providing procedural guidance and will be determined by the procedure specialist. After flight inspection verifies the aiming point, it will not be changed without the concurrence of the procedure specialist. When the system no longer delivers the aircraft to the established aiming point and the system cannot be adjusted to regain the desired alignment, consideration should be given to amending the procedure.

Category II/III services require the use of radio altimeter. Irregular terrain features could cause erratic radio altimeter indications. On commissioning, report the radio altimeter indication at Category II Decision Height (DH). For periodic, record the radio altimeter indications for engineering analysis purposes.

214.32012 Missed Approach. Flight inspection of the missed approach segment will assure that the designed procedural altitudes provide obstacle clearance per paragraph 214.3e. The flight inspector shall also determine that the procedure is safe and operationally sound for the category aircraft intended. For periodic inspections, fly the missed approach procedure to a point where the flight inspector can identify any obstacles that could be a potential hazard.

214.32013 Circling. The flight inspector shall verify that proposed circling maneuvers are safe and sound for the category of aircraft proposed. Procedural altitudes shall be evaluated per paragraph 214.3e.

214.32014 Visual Segment. Helicopter point-in-space and some other procedures have extensive visual segments between the MAP and landing area. Evaluate these segments for operational suitability and safety. Recommend procedural adjustments when buildings or obstructions obscure access to the landing area. Procedures proposed for night use shall be evaluated at night prior to commissioning.

214.32015 Charted Visual Approaches. A commissioning check of charted visual procedures is required. Determine flyability and ensure that depicted landmarks are visible in both day and night visual conditions. Flyability is determined by difficulty of aircraft placement, cockpit workload, landmark identification, location and visibility, and VFR obstacle clearance. Both day and night evaluations must be complete prior to authorizing use of the procedure. There are no periodic requirements.

214.3202 En route/Terminal Routes. Evaluate each en route or terminal segment during commissioning flight inspection to ensure that the proposed minimum obstacle clearance altitude (MOCA) is adequate per paragraph 214.3e.

214.32021 Minimum En route Altitude (MEA) and Changeover Points. The MEA and change-over points shall be predicated on minimum obstruction altitude (MOCA), minimum reception altitude (MRA), airspace, and communication requirements. If more than one of the above altitudes is procedurally required, the highest altitude determined through flight inspection will become the minimum en route altitude.

214.32022 Maximum Authorized Altitudes (MAA). MAAs are limitations based on airspace restrictions, system performance characteristics, or interference predictions. If the MAA are based on an interference problem, the source of the interference must be identified and corrective action initiated where possible.

214.3203 Fixes/Holding Patterns. Controlling obstacles shall be verified to ensure the adequacy of minimum holding altitude (MHA) per paragraph 214.3e. System performance will be evaluated to ensure conformance with appropriate tolerance sections of this manual. If system performance and obstacle clearance data are on file, flight inspection of the procedure is not required.

214.3204 Air/Ground Communications. Air/ground communications with ATC must be satisfactory at the initial approach fix (IAF) minimum altitude and at the missed approach altitude. Satisfactory communications coverage over the entire airway or route segment at minimum en route IFR altitudes shall be available with an ATC facility. Where ATC operations require continuity in communication coverage and ATC requests verification, flight inspection shall evaluate that coverage in accordance with appropriate sections of this order.

214.3205 Area Navigation (RNAV), GPS, FMS. All procedures based on RNAV, GPS, or FMS shall be evaluated by flight inspection for conformance to safe and sound operational practices. Flight inspection of these procedures shall, as a minimum, evaluate the following:

a. Waypoint accuracy;

b. Bearing accuracy;

c. Distance accuracy;

d. Conformancy with paragraph 214.3a;

e. Obstacle clearance per paragraph 214.3e;

f. System support of the procedure at altitudes proposed for use.

214.32051 Detailed Procedures

a. The flight inspector shall review and evaluate each segment of the procedure for conformance with safe and sound operational practices. Where required, the flight inspector shall coordinate and brief ATC on special handling requirements and procedural operation. Prior to flight, the inspector shall verify that all supporting equipment or systems are in place and functioning (e.g., Rho Theta systems in operation, satellite ephemeral data and availability, etc.).

(1) Waypoint Accuracy. The purpose is to verify that the waypoints as depicted on the procedure are properly labeled and correct. Rho-Theta systems shall properly depict supporting facilities; systems utilizing coordinates are depicted in a manner compatible with equipment requirements. Specific equipment tolerances or displacement errors are addressed in other portions of this order. The procedure will comply with tolerances listed in the appropriate section.

(2) Bearing and Distance Accuracy. The determination of true bearing and distance accuracy to and between waypoints is through a comparison of the designed procedural data and the displayed bearings and distances of the AFIS, FMS, or GPS, etc., equipment designated in applicable chapters for the inspection. On periodic inspections, the published data shall be compared to the designed and displayed values. Where there is out-of-tolerance disagreement, the procedure will be denied and the procedures specialist advised. Periodics on procedures not in the database shall be checked using commissioning procedures.

(3) The flight inspector shall evaluate all facets of the procedure to ensure compliance with safe operating practices. The evaluation shall include the clarity and readability of the depiction and that workloads imposed on the air crew to select or program the procedure are reasonable and straightforward. Objective and professional judgment from air crews trained in flight inspection is expected.

(4) Runway Markings, Lighting, and Communication. The flight inspector shall evaluate the suitability of the airport to support the procedure. Unsatisfactory or confusing airport markings, non-standard or confusing lighting aids, or lack of communication at critical flight phases may be grounds for denying the procedure. In all cases, the procedure specialist will be appraised of the conditions discovered during the flight inspection.

(5) Applicable System Support. The variation in systems dictates a progressive approach in determining evaluation methods. Study of the procedure by the flight crew prior to flight will normally reveal the type of system verification required. Where a ground-based NAVAID supports the procedure, the flight inspector shall verify its status prior to flight. RNAV systems will be evaluated through emulation with AFIS aircraft. Where emulation is not possible, the procedure will be performed in an aircraft certified for the procedure with the flight inspector aboard and in a position where evaluation per paragraph 214.32051a(3) can be accomplished.

b. En route and terminal route segments shall be flown at the proposed MEA using the applicable system for guidance and to or from a point where course or obstacle clearance has been established. In the case of a SID/DP, the procedure shall be evaluated to an established NAVAID or fix or to a point where en route obstacle clearance has been established. For STAR type procedures, the route shall be evaluated to where the route intercepts a portion of an established SIAP or procedure from which a normal descent and landing can be accomplished. Periodic inspection of en route and terminal route segments is not required.

c. Standard Instrument Approach Procedures (SIAP). All standard instrument approach procedures intended for publication shall be inflight evaluated. The final approach trapezoid shall be evaluated per paragraph 214.3e. The final approach segment shall be flown to an altitude 100 ft below the proposed minimum descent altitude. Approaches with precision vertical guidance shall be evaluated to the proposed decision or missed approach altitude. Misalignment or inaccurate data indications will be forwarded to the procedure specialist for further review prior to commissioning the procedure.

d. Inspector Authority. At commissioning, the flight inspector has the discretion to reject the procedure if it does not constitute a satisfactory maneuver from a human factors/flyability standpoint. Concerns must be resolved with procedures and/or supervisory personnel prior to commissioning. During subsequent checks of a commissioned procedure, new obstruction and/or signal problems constitute reason for a flight inspector to deny or modify a procedure by NOTAM. Human factors/flyability concerns during subsequent checks must be resolved with procedures and/or supervisory personnel before any changes are issued.

214.4 ANALYSIS. Flight inspection determines that the procedure is flyable and safe. If a new procedure is unsatisfactory, the flight inspector shall coordinate with the procedure specialist to determine the necessary changes. When an existing procedure is found unsatisfactory, initiate NOTAM action immediately and advise the procedure specialist.

214.41 Cartographic Standards. Changes to cartographic standards are the responsibility of the Interagency Air Cartographic Committee and the Intra-Agency Committee for Flight Information. Recommendations for changes to these standards should be sent to the Office of Aviation System Standards, Flight Inspection Operations Division, AVN-200, for consolidation and forwarding to the appropriate committee.

214.42 Night Evaluations.

a. For new flight procedures at airports with no prior IFR service, a night flight inspection shall be conducted to determine the adequacy of airport lighting systems prior to authorizing night minimums.

b. Inspect light systems during the hours of darkness. Evaluate the light system for:

(1) Faithful representation of the depiction (correct light pattern);

(2) Operation in the manner proposed (e.g., photocell, radio control etc.);

(3) Local lighting patterns in the area surrounding the airport do not distract, confuse, or incorrectly identify the runway environment.

214.43 Human Factors are concerned with optimizing the relationship between people and their activities by systematic application of human sciences integrated within the framework of systems engineering. In the context of flight inspection, it is a question of whether a flight procedure is operationally safe and flyable for a minimally qualified sole pilot flying an aircraft with basic IFR instrumentation in instrument meteorological conditions using standard navigation charting.

The criteria used to develop instrument flight procedures represent many factors such as positioning requirements, protected airspace, system and avionics capabilities, etc. Human factors such as cockpit workload, pilot error, and memory limitations have been considered. Sensory, perceptual, and cognitive restrictions historically have been incorporated in the criteria only to a limited extent; e.g., length of approach segments, descent rates, turn angles, etc. These are products of subjective judgments in procedure development and cartographic standards. It is incumbent upon the flight inspector to apply the principles of human factors when certifying an original or amended procedure. The following factors shall be evaluated:

a. Complexity. The procedure should be as simple as possible. It should not impose an excessive workload on a sole pilot flying a minimally equipped aircraft.

b. Interpretability

(1) The final approach course should be clearly identifiable, with the primary guidance system or NAVAID unmistakable;

(2) The procedure should clearly indicate which runway the approach serves and indicate which runway(s) circling maneuvers apply to;

(3) Areas not to be used for maneuvering shall be clearly defined.

c. Human Memory Considerations. Pilots must be able to extract information quickly and accurately during an instrument approach. Multiple tasks complicate the memory process and tend to produce prioritization during stressful phases of flight. Workload reduction can be accomplished through methodical chart layout that encourages the pilot to periodically refer to the depicted procedure rather than trying to memorize complex maneuvers.

214.5 TOLERANCES. The procedure should be safe, practical, and easily interpreted with minimal additional cockpit workload. Supporting facilities/ systems shall meet tolerances of the appropriate sections of this manual and not contribute to operational confusion.

214.6 ADJUSTMENTS. See Section 106, paragraph 106.45.

SECTION 215. SURVEILLANCE RADAR AND AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS)

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SECTION 215. SURVEILLANCE RADAR AND AIR TRAFFIC CONTROL RADAR BEACON SYSTEM, (ATCRBS)

215.1 INTRODUCTION. This section outlines procedures for the flight inspection of surveillance radar and the air traffic control radar beacon system (ATCRBS), referred to as secondary radar. The procedures for radar flight inspection differ from the procedures for NAVAID's in that most of the data collection and analysis are conducted on the ground. The flight inspector's role is primarily one of providing a known target in a designated area. Present digital techniques allow the evaluation of most radar parameters by the use of statistical sampling of aircraft returns in the normal day-to-day radar environment. Certain requirements must be completed using a flight inspection aircraft. Facilities maintenance personnel will use targets-of-opportunity, radar data analysis software (RDAS) tools, and other test equipment to the extent practicable for completing all checklist requirements. Facilities maintenance personnel will normally evaluate and document all facility performance parameters, except those specifically evaluated by the flight inspector. Airway Facilities will prepare a radar inspection plan for all commissioning inspections, as well as all special inspections involving coordination outside the facility of concern. Joint use facility (radar data used by both FAA and DOD) inspection plans require coordination between the FAA region and the DOD user.

215.11 Surveillance (Primary) Radar. Primary radar relies on reflected radio energy to provide a video target on the controller's display. The radar return varies in strength due to atmospheric conditions, target range, radar cross section, aircraft reflective surfaces, and other phenomena.

215.12 ATCRBS (Secondary) Radar. Secondary radar overcomes some of the basic problems of primary radar. Secondary radar relies on electronic replies from a transponder system in the aircraft, generated as a result of interrogations from the ground system. Transponder replies can be used for improved target identification (assigned beacon code) and for aircraft altitude information from Mode-C equipped transponders. The ATCRBS normally provides improved coverage over primary radar. ATCRBS coverage is a function of many factors, including siting and antenna patterns. The ATCRBS is normally inspected simultaneously with the primary radar system.

215.13 Minimum Safe Altitude Warning System (MSAW). MSAW is a software function of the Automated Radar Terminal System (ARTS) designed to generate an alert when an associated aircraft with Mode-C is at or predicted to be at an unsafe altitude. MSAW monitors aircraft for terrain and obstacle separation and will generate an alert, both aural and visual, on the display of the air traffic controller. MSAW consists of two detection components, the general terrain map (GTM) and the approach path monitor (APM).

a. GTM. The GTM exists within a 55 nm radius of the associated ASR site and consists of 4,096 bins which are 2 nm square. Each bin is assigned an alert altitude determined by the highest terrain or obstacle that affects the bin plus 500 ft. When an aircraft is below, predicted to be below, or projected to be below the bin altitude, an alert is generated.

b. APM. An APM is normally 1 nm wide, either side of final approach course or runway heading. An APM starts at approximately 5 nm (or final approach fix) from the approach end of runway. The APM terminates at approximately 1 nm from the approach end of the runway. An altitude value is determined for obstruction clearance for each APM at the beginning and at the end of the APM. These two values provide MSAW protection as an aircraft descends along the approach path towards the runway. Parallel runways utilize the same APM. For a circling only SIAP, the APM starts at 5 nm (or final approach fix) from the closest landing surface and terminates 1 – 2 nm from the closest landing surface.

215.2 PREFLIGHT REQUIREMENTS/ INSPECTION PLAN. The AF regional maintenance engineering office and/or military equivalent is responsible for preparing the Operational Performance Inspection Plan in accordance with FAA Order 6300.13, Radar Systems Optimization and Flight Inspection. An inspection plan is required for all commissioning inspections and special inspections requiring coordination outside the facility of concern.

Simple special inspections that do not require coordination outside the local AF/Maintenance and AT offices may not require a formal inspection plan but should always be documented. Representatives of Air Combat Command (ACC) will participate in the planning and inspections of a JSS site.

215.21 Facilities Maintenance Personnel. The appointee preparing the inspection plan shall coordinate with all associated offices. For en route sites, the attendees shall be: AF representatives from the ARTCC and the remote site, AT representatives from the regional office and the ARTCC, and a FICO representative. The DOD user and appropriate Air Combat Command representative should attend planning meetings to identify operational requirements and evaluation objectives for a JSS. For terminal radar inspections, the appointed coordinators shall include AT representatives from the region and local site, an AF representative from the systems maintenance office, and a FICO representative. Military offices shall provide plan preparation and the required coordination for joint use and military sites. The appointee for special plan preparation shall be assisted by representatives from each office of concern. This assistance will be requested from specific offices when required. In addition to the procedures specified in Section 106, facilities maintenance personnel shall ensure the following items are addressed in the inspection plan:

a. The Objectives of the Inspection. These objectives will determine who shall assist and provide input for the draft of the plan and the methods used to perform the various checks and what checks will be performed by facilities maintenance personnel and flight inspection.

b. Prepare a List of Operational Requirements. These requirements shall describe in detail all routes, fixes, holding patterns, and approach and departure procedures. These details shall include specified altitudes, distances, and other pertinent information. The list of routes, fixes, etc., may then be divided between evaluations using targets-of-opportunity and those requiring a flight inspection aircraft. A flight inspection aircraft will normally be used in areas with low traffic activity, where siting criteria predicts marginal or no coverage, or where fix/map accuracy must be determined. The flight inspection phase of the plan may be further divided into checks requiring an aircraft with a calibrated transponder and those which can be completed using a small aircraft equipped with an approved transponder. When assigned to inspect or evaluate a military/JSS facility, the Air Combat Command representative shall perform all coordination and notification requirements, complete the flight phase planning, and publish required documents.

c. Describe the Resources Required. This list shall include personnel, aircraft, special tools and equipment, equipment calibration, computer time and software, charts, graphs, maps, etc. The inspection plan shall also include all data required to prepare, conduct, and document the inspection.

d. Flight Scheduling. Recommend, if appropriate, the best flight period for evaluating coverage. The flight period will usually be a compromise between operational and engineering needs. This compromise is required because AT prefers to handle flight inspection aircraft during periods of low traffic activity; however, the AF engineer may require some portions of coverage checks during peak traffic periods.

e. Radar Equipment Performance. Ensure the radar equipment is tuned to facility operational specifications prior to the flight inspection. A joint inspection is required to measure and optimize JSS equipment parameters.

f. Participating Personnel. Ensure participating maintenance and operations personnel (including military) are experienced and familiar with the objectives of the inspection and the requirements of this order.

g. Inspection Plan Ensure the inspection plan includes a sequence of events to minimize aircraft flight time and the inconvenience to operating traffic. This portion of the plan shall be used as a schedule of events during the inspection activities.

h. Final Plan. Ensure the final plan is reviewed and signed by representatives from AT, the FIO, the military when appropriate, and AF.

i. Consolidated Inspection Data. Consolidate and evaluate all inspection data obtained using targets-of-opportunity and advise the flight inspector of additional checks that require the use of a flight inspection aircraft.

j. Interrogator Calibration Values. Furnish the interrogator power values (in watts at the antenna) for inclusion in the flight inspection report.

215.22 Flight Personnel. Prepare for the flight inspection in accordance with Section 106. In addition:

a. Flight Inspection Coordinator. The FICO shall appoint a qualified flight inspection pilot as coordinator for each commissioning radar inspection, and special inspection as required, in accordance with paragraph 215.21.

b. Inspection Plan. A copy of the inspection plan and a current briefing concerning the operational requirements, expected facility performance, and the performance evaluations obtained using targets-of-opportunity shall be provided to the flight inspector. This information will be used to determine the extent of the flight inspection.

c. Checklist Requirements. Assist facilities maintenance personnel in determining which checklist requirements have been completed. The role of the flight inspector will vary greatly depending upon the type, sophistication, intended use, and location of the radar facility. For instance, an FAA en route radar may only require the flight inspector complete a portion of the vertical coverage check, whereas a mobile terminal radar may require a dedicated aircraft for all the checklist requirements.

d. Aircraft Requirements. Flight inspection aircraft used for ATCRBS and primary radar checks are equipped with a transponder that has been FAA-calibrated in accordance with applicable avionics maintenance standards. The transponder power output and sensitivity are pilot-selectable per the following table.

FLIGHT INSPECTION TRANSPONDER SWITCH SETTINGS		FLIGHT INSPECTION TRANSPONDER PARAMETERS	
Flt Insp Select	**Lo-Power Select**	**Rx Sensitivity**	**Tx Power**
OFF	OFF	Normal (-75 dBm)	Normal (350 watts)
ON (barber pole lit)	OFF	Low (-69 dBm)	Normal (350 watts)
ON (barber pole lit)	ON (barber pole lit)	Low (-69 dBm)	Low (88 watts)

215.23 Minimum Safe Altitude Warning (MSAW). Flight inspection of MSAW is a test of the ARTS software. There are no flight inspection tolerances.

The flight inspection crew will fly the detailed procedures as outlined in paragraph 215.33. Site specific data are available through the MSAW Web Site. This data will list all Approach Path Monitors (APM's) within the associated ASR coverage area. One General Terrain Map (GTM) check will be completed during the periodic interval. The flight inspection aircraft is a dedicated target for the alert check. Air Traffic/AOS determines the final status of MSAW. The reported results will be based on the controller announcing that MSAW alerted or failed. Annotate on the DFL any MSAW alert failure. No MSAW flight inspection report is required. The FICO shall report all MSAW alert failures to the Airway Facilities Operational Support (AOS) MSAW Safety Team.

a. Preflight Coordination. The flight inspector shall ensure the following:

(1) When accessible, obtain site-specific data required for the check from the MSAW Web Site. If Internet access is not available, this data may be available from the FICO.

(2) Coordination with the air traffic representative has been accomplished prior to beginning an inspection.

(3) The altitudes to be flown and MSAW altitude alert points are clearly defined and understood.

(4) Conduct all flight inspection for MSAW in day VFR conditions.

b. MSAW is an ARTS software function. MSAW results do not affect the associated ASR status.

215.3 FLIGHT INSPECTION PROCEDURES

a. General. Radar flight inspections may vary from a single (special inspection) requirement such as radar coverage over a new air traffic "fix," to a complete en route radar commissioning inspection at an ARTCC. The number of personnel, coordination, preparation, and reporting required for inspections varies widely. An inspection normally consists of three distinct parts; planning, engineering, and documentation. The planning phase results in the flight inspection plan. The engineering or equipment phase includes necessary tests to ensure the radar system performs to design specifications. Although this phase is primarily an AF engineering function, some tests may require a flight inspection aircraft. When multiple approved procedures are listed, the AF engineering representative can select which procedure is to be used. The tests required during the engineering phase are referenced in paragraph 215.31, Checklist, and paragraph 215.32, Detailed Procedures. The documentation or flight inspection portion determines if AT requirements are met and establishes a radar coverage baseline. AT requirements are outlined in the facility siting report and the inspection plan.

The detailed flight inspection procedures are covered under paragraph 215.32.

b. Commissioning Inspections. The objective of the commissioning inspection is to evaluate system performance, determine and document the site coverage, and provide a baseline for the detection of a deterioration in equipment performance. Data obtained during this inspection will be used for daily comparison of facility performance, as well as future inspections. The commissioning is the most thorough inspection and requires a correspondingly detailed plan and report.

c. Periodic Inspections. ASR's with either surveillance approaches or MSAW function require a periodic flight inspection.

d. Special Inspections. Special inspections are conducted to fulfill a particular need and may be very limited in scope. The limited inspection may not require a formal written plan, and only a short inspection report. If equipment changes or modifications to commissioned facilities change the coverage pattern, document the changes in the inspection report. The new coverage pattern then becomes the basis for comparison during subsequent inspections. Coordination with appropriate military personnel is vital at joint-use sites. Special inspections include the following:

(1) Engineering Support. Engineering support is performed to help engineering and AT personnel determine if the radar meets equipment certification and operational requirements. This data may be used for commissioning purposes, provided no equipment modifications are made prior to the commissioning inspection. Requirements for specific checks will be determined by facilities maintenance personnel and need not conform to a specific format.

(2) Antenna Change. Paragraph 215.31, Checklist, identifies requirements for the installation of a new antenna of the same or different type. If there is a question concerning the characteristics or type of antenna being installed, the AF engineer in charge will determine which antenna change checklist applies. A flight inspection is not required following an antenna pedestal or rotary joint change, provided the ground measurements of the reflector position, feedhorn alignment, and antenna tilt of the replacement pedestal, are satisfactory. Refer to paragraphs 215.3204d(4) and (5) for antenna change procedures.

(3) Major Modifications (other than antenna change). This inspection plan, inspection, and report should be confined to the parameters necessary to confirm facility performance. The radar engineer shall determine the extent of a special inspection during preparation and coordination of the plan. Depending upon the extent of the modification, an inspection using RDAS tools and targets-of-opportunity may satisfy the inspection requirements.

(4) Near-Midair-Collision Inspections. These inspections are conducted at the request of the AT manager of the facility involved. The inspection determines the radar coverage in the area where the incident occurred. The flight inspection shall be conducted as soon as possible following the near-midair-collision, duplicating the maneuvers, altitude, and direction of flight of the incident aircraft. The radar shall be operated in the same configuration, to the extent practicable, as it was at the time of the incident. Near-midair flight inspection reports shall be submitted in the same manner as after-accident reports (see Order 8240.36, Instructions for Flight Inspection Reporting).

215.31 Checklist. The checks requiring a flight inspection aircraft are identified in the checklist and appropriate "detailed procedure" paragraphs. The procedures presented here may be used singly when a special inspection may be satisfied with one or more of the individual tests. The checklist items identified by an "X" are mandatory. Facilities maintenance personnel shall evaluate the data obtained using targets-of-opportunity to determine if further evaluation by a flight inspection aircraft is required. The flight inspector shall consult with the radar engineer prior to departing the area to ensure that all checklist requirements have been completed. The following checklist items must be completed on each primary or secondary radar commissioning inspection.

CHECKLIST

		C	**P**	**Antenna Change**						
				Primary		**ATCRBS**			**FI Transponder Settings**	
	Para Ref			Same Type	Diff Type	Same Type	Diff Type	Major Mods	Lo-Pwr Select	Flt Insp Select
Orientation	215.3201	X		X	X	X	X	X	OFF	ON
Tilt	215.3202	X			X		X		OFF	ON
Primary Rdr Optim	215.3203									
ATCRBS Power Optim	215.3212	X, 1					X, 1		OFF	ON
SLS/ISLS	215.3210	X					X		OFF	ON
Modes/Codes	215.3211	X							OFF	ON
GTC/STC	215.3213	X					X		ON	ON
Vertical Coverage	215.3204	X			X		X		ON OFF	ON (Below 15,000 ft MSL) ON (Above 15,000 ft MSL)
Horiz Screening	215.3205								OFF	ON
Airways/Route Coverage	215.3206	X,1							OFF	ON
Fix/Map Accuracy	215.3207	X							OFF	ON
Fixed Tgt Ident	215.3208	X							OFF	ON
Surveillance Apch	215.3209	X,1	X,1	X,1	X,1				OFF	ON
Communications	215.3214	X	X						As requested	
Standby Equip	215.3215	X							As requested	
Standby Power	215.3216	X							As requested	
MSAW - GTM (2)	215.33	X	X						OFF	OFF

NOTES: C = Commissioning P = Periodic

X Denotes mandatory check; see text for approved procedure. All other checks are at engineering/maintenance/controller request.

1 Requires Flight Inspection aircraft for final evaluation. All other checks may be accomplished by software analysis using targets of opportunity or radar data acquisition subsystems (RDAS).

2 APM checks are normally scheduled in conjunction with the SIAP.

215.32 Detailed Procedures

a. General. Facilities maintenance personnel shall use operational displays for target grading and guidance information. Facilities maintenance personnel shall configure the radar in its lowest usable configuration (the traditional worst case configuration, all enhancements on, may degrade newer "smart" radars to the point that they become unusable). Data from the operational displays and automation diagnostic and analysis programs will determine if the system supports operational requirements. When using targets-of-opportunity, multiple target returns are required to ensure accuracy. Verify questionable accuracy with a flight inspection aircraft.

b. Evaluation ATCRBS and primary radar shall be evaluated simultaneously throughout the inspection whenever possible. If ATCRBS replies obscure the primary targets, the displayed ATCRBS should be offset slightly to allow evaluation of both replies.

c. Inspection Sequence. The engineer shall ensure the radar facility is operating according to design specifications before any inspection tests begin. The inspection should start with orientation, tilt, and an initial ATCRBS power setting. During installation, the antenna is normally set to the tilt recommended in the siting report and the azimuth is set to a prescribed reference. These settings should provide adequate accuracy for the initial tests. The initial ATCRBS power may be set to either a theoretical value or a setting that will interrogate aircraft at maximum radar range. After refining these preliminary settings and becoming confident in them, the engineer should use targets-of-opportunity to ensure that primary and secondary coverage is at least as good as that required in the overall quality test. Tests which can be completed without using a flight inspection aircraft should be conducted prior to the arrival of the flight inspection aircraft. At joint-use sites, inspection sequence may vary, in order to satisfy the requirements of all agencies concerned.

> **NOTE:** Parameter changes that occur during the flight inspection aircraft evaluation may require a repetition of previously conducted tests.

215.3201 Orientation.

a. Purpose. To verify the radar azimuth corresponds with a known azimuth position and may be conducted with a flight inspection aircraft or ground check.

b. Approved Procedures.

(1) Fly inbound or outbound radially over a well-defined ground checkpoint or position the aircraft using AFIS. The altitude and distance of the checkpoint should be well inside the radar coverage limits.

(2) A radar PE, maintenance beacon, or MTI reflector of known location may be used to determine alignment of the radar azimuth in lieu of a flight inspection aircraft.

c. Evaluation. Compare the azimuth observed by the controller with the magnetic azimuth of the checkpoint.

215.3202 Tilt Verification

a. Purpose. To verify the primary and secondary radar antenna tilt settings are optimum and the mechanical antenna tilt indicators are accurate.

b. Approved Procedure. Facilities maintenance personnel shall direct the aircraft through the heaviest ground clutter within operational areas so the predetermined angle can be evaluated and adjustments made if required. If radar coverage is acceptable and the radar range is satisfactory, complete the remaining portions of the flight inspection. If parameters are not acceptable, it will be necessary to reestablish the antenna tilt angle. In this case, re-accomplish any previously completed flight inspection procedures using the new antenna tilt angle.

c. Evaluation. The tilt selection process considers the interaction of various radar parameters and the final radar system performance. The optimum tilt angle is a compromise between coverage (with/without MTI) over clutter and range coverage.

215.3203 Primary Radar Optimization

a. Purpose. To aid in maximizing the radar's potential. Adjustments in STC, beam gating, receiver sensitivity, pulse width, etc., may improve a radar's performance.

b. Approved Procedure. Facilities maintenance personnel will provide a detailed flight profile.

c. Evaluation. Facilities maintenance personnel will observe the target display and adjust the radar as necessary.

215.3204 Vertical Coverage

a. Purpose. To determine and document the coverage in the vertical plane of the primary and ATCRBS antenna patterns. Evaluate the inner and outer fringes on all primary and secondary radars.

b. Vertical Coverage Azimuth. Choose an azimuth from the radar antenna or coincident VOR/TACAN radial from the radar antenna which is free of clutter, dense traffic, heavy population areas, and interference created by line-of-site obstructions. Conduct the commissioning inspection and all subsequent inspections concerning facility performance, on the same azimuth for comparison purposes. For inspection at altitudes above flight inspection aircraft service ceiling, Airway Facilities/Air Traffic has the option of using targets of opportunity/RDAS.

c. Configuration: Facilities maintenance personnel shall determine the lowest usable radar configuration. Suggested configurations are as follows:

Antenna Polarization	Circular
Diplex Systems	Simplex mode
Integrators/Enhancers	OFF
Magnetron/Amplitron Systems	Amplitron (See Note)
Video Processor (military mobile radar)	OFF
ASR-9 Display Video	Uncorrelated
ARSR-3:	
Target Threshold:	91
MTI: I & Q	"I"

NOTE: At the request of engineering, conduct an additional vertical coverage check for the ARSR 1 & 2 with the amplitron OFF. It is not necessary to conduct the entire vertical coverage; only a spot check of altitudes and ranges, as specified by the engineer.

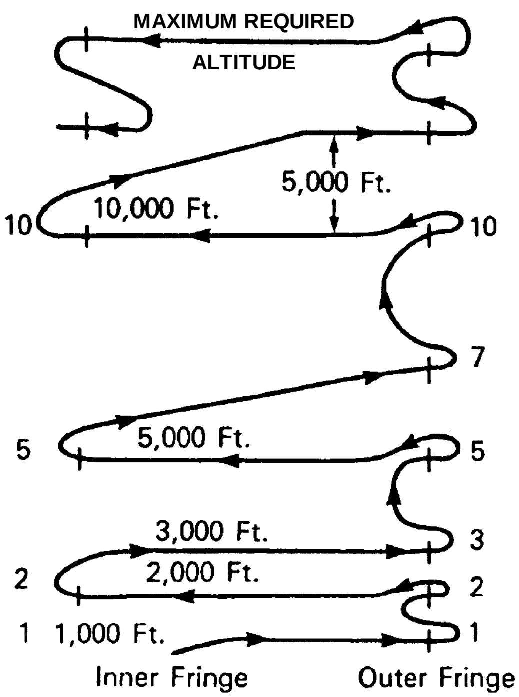
d. Approved Procedures. Targets-of-opportunity may be used to check the vertical coverage, provided that sufficient targets are present to verify the coverage volume. When using targets-of-opportunity, multiple target returns are required to ensure accuracy. Verify questionable accuracy with flight inspection aircraft. When using a flight inspection aircraft, determine the outer fringe coverage by evaluating tail-on targets and the inner fringe coverage by nose-on targets. When special requests are made by facilities maintenance personnel to evaluate target returns at the outer fringe with nose-on targets, clearly differentiate between nose-on and tail-on results on the flight inspection report. Aircraft reflective surfaces and transponder antenna radiation characteristics vary between inbound and outbound flight; consequently, differences in coverage can be expected. The flight inspector shall obtain the vertical coverage azimuth and maximum required altitude from the facilities maintenance personnel. Use map checkpoints, a NAVAID radial, AFIS, or radar vectors to remain on the vertical coverage azimuth. Fly all pattern altitudes as height above the radar antenna.

Note: For inspections of USAF mobile facilities where the operational requirements do not dictate flying the profile to the outer fringe, or the complete coverage check is not requested, the coverage will be requested to operational range requirements plus at least 10%. A statement should be made in the Remarks Section that coverage was made to operational requirements plus 10%, and the vertical coverage plot is not to the limits of radar coverage. The facility will be restricted.

(1) Commissioning Vertical Coverage Profile, ASR/ATCRBS. Refer to the Checklist in paragraph 215.31 and to Figure 215-1 and proceed as follows:

Figure 215-1

Commissioning--ASR/ATCRBS Vertical Coverage Profile



(a) Determine the inner fringe at 1,000 ft. Then fly outbound at 1,000 ft and establish the outer fringe.

(b) Climb to 2,000 ft and establish the outer fringe. Then proceed inbound at 2,000 ft and establish the inner fringe.

(c) Climb to 3,000 ft and establish the outer fringe.

(d) Climb to 5,000 ft and establish the outer fringe.

(e) Repeat the outer fringe check at 5,000 ft (or lower if necessary) to evaluate radar auxiliary functions such as linear polarization, pin diode, integrators, etc., on the primary and GTC/STC on the secondary radar. Linear polarization normally increases the usable distance, so this check should be performed at an altitude where the change can be observed. Most auxiliary functions produce a decrease in receiver sensitivity, thereby decreasing the usable distance. Conduct these tests by establishing the outer fringe with the function on, and then off, and noting the difference in usable distance.

(f) Return the equipment to its original inspection configuration and proceed inbound at 5,000 ft and establish the inner fringe.

(g) Climb to 7,000 ft and establish the outer fringe.

(h) Climb to 10,000 ft and establish the outer fringe. Then proceed inbound at 10,000 ft and establish the inner fringe.

(i) If the maximum required altitude is greater than 10,000 ft, check the outer fringe in 5,000 foot increments up to the maximum required altitude; e.g., if 17,000 ft, check the outer fringe at 15,000 and 17,000 ft, then proceed inbound at the maximum required altitude and establish the inner fringe. If satisfactory radar coverage is not maintained during this inbound run, conduct additional flights through the vertical coverage pattern and establish the maximum usable altitude.

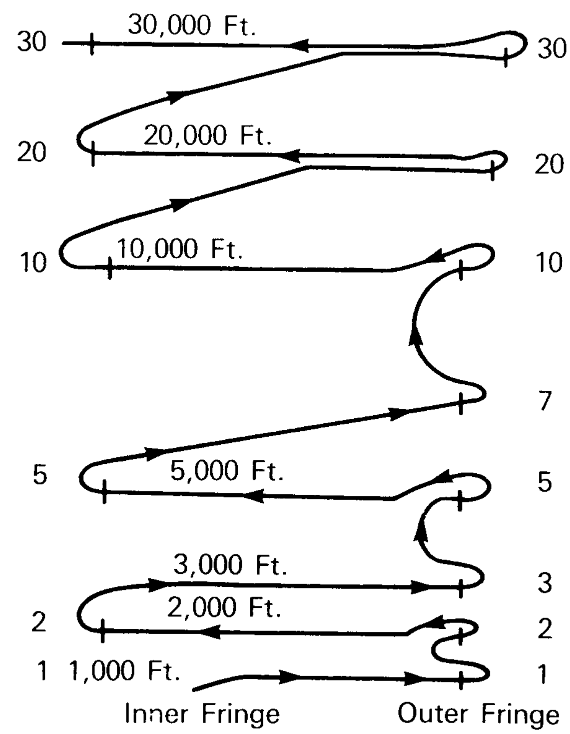
(j) Check the inner fringe at the altitudes used to establish the outer fringe stepping down in altitude to the 10,000-foot level.

NOTE: If the maximum required altitude is 10,000 ft or lower, do not inspect vertical coverage above this altitude unless requested.

(2) Commissioning Vertical Coverage Profile, ARSR/ATCRBS.

Figure 215-2

ARSR/ATCRBS Vertical Coverage Profile



(a) Complete steps (a) through (h) of the ASR commissioning requirements in paragraph 215.3204d(1).

(b) Climb to 20,000 ft and establish the outer fringe. Then proceed inbound at 20,000 ft and establish the inner fringe.

(c) Climb to 30,000 ft and establish the outer fringe.

(d) Repeat the outer fringe as required to conduct auxiliary functions tests.

(e) Then proceed inbound at 30,000 ft and establish the inner fringe.

(f) If operational or engineering requirements are greater than 30,000 ft or 30,000 ft conflicts with air traffic, climb to a mutually agreeable altitude and establish the outer and inner fringes.

(3) Commissioning Inspection - Military BRITE/DBRITE Display. Inspect an ASR which has the sole function of providing a video source for a BRITE/DBRITE display to operational requirements or 4,000 ft/10 miles, whichever is greater.

(a) Determine the inner and outer fringes at every 1,000-foot level up to 4,000 ft or the operational altitude.

(b) No comparative equipment auxiliary function configuration checks are required.

(c) Target definition will be from the BRITE display.

(d) There are no periodic inspection requirements.

(4) Primary Radar Antenna Change. When the primary ASR or ARSR antenna is changed, fly the vertical coverage profile depicted in figure 215-3 or 215-4, as applicable.

(a) After determining the outer fringe at 5,000 ft, repeat the outer fringe check, as required, to evaluate auxiliary functions as requested by facilities maintenance personnel. Conduct the remainder of the coverage check in the original configuration.

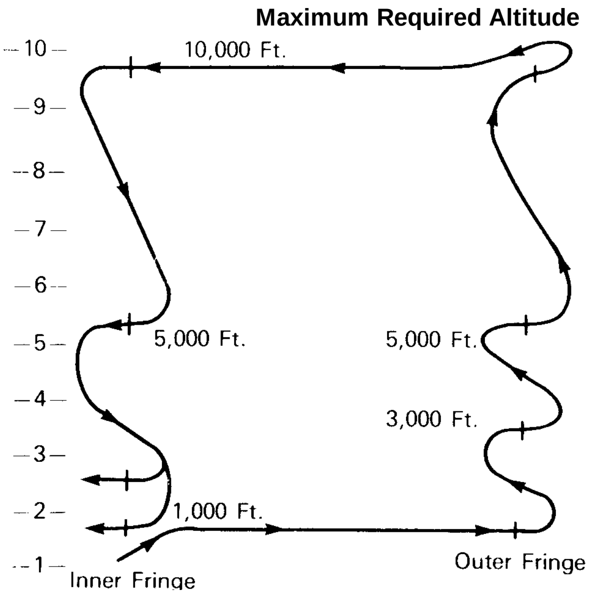
(b) Checks of additional facility equipment configurations and altitudes will be at the option of facilities maintenance personnel.

(5) ATCRBS Antenna Change. When replacing the antenna with the same type, all inspection requirements may be completed using targets-of-opportunity. When the antenna is replaced with a different type, checklist requirements shall be completed using a flight inspection aircraft as required by the Checklist.

(a) Terminal Radar. The profile for a primary radar antenna change is indicated in Figure 215-3.

Figure 215-3

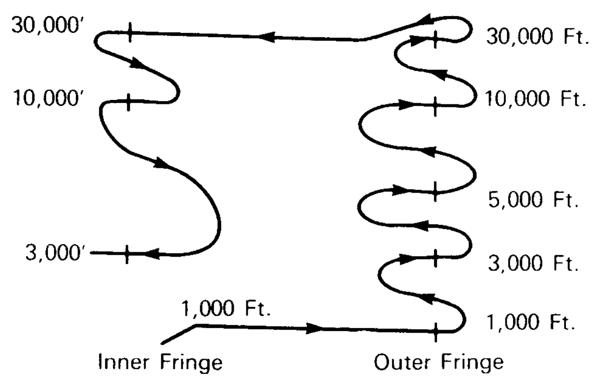
Antenna Change--ASR/ATCRBS



(b) En Route Radar. The profile for a primary radar antenna change is indicated in Figure 215-4.

Figure 215-4

Antenna Change--ARSR/ATCRBS



e. Evaluation. Facilities maintenance personnel shall record target strength as defined in paragraph 215.5a on each scan, aircraft position every five miles, and aircraft altitude for each fringe check and level run. Facilities maintenance personnel shall document results of the vertical coverage check using analysis/diagnostic programs (RDAS tools), when available, for inclusion in the facility report.

215.3205 Horizontal Screening

a. Purpose. To verify the indicated coverage on the horizontal screening charts. This test is optional depending upon operational requirements and ground evaluation tools available. After reviewing the results of the vertical coverage check and other data, engineering personnel will determine if the horizontal coverage check is required.

b. Approved Procedure. Fly an orbit at an altitude and distance which corresponds to the lowest screening angle at which coverage is expected. Do not use an orbit radius of less than ten miles. AFIS, DME, or vectors provided by the controller may be used to maintain the orbit. MTI, if used, should be gated to a range inside the orbit radius, except where ground clutter obscures the targets unless MTI is used. If MTI is gated outside of the orbit, the radius of the orbit must be constantly changed to avoid target cancellation due to tangential blind speed. For example, vary the distance on a 12-mile orbit between 10 and 14 miles, flying oblique straight courses between the 10-mile and 14-mile orbits, so as to average a 12-mile orbital distance.

c. Evaluation. Facilities maintenance personnel shall record target strength, azimuth and distance every scan. They shall determine if the coverage supports operational requirements.

215.3206 Airway/Route Coverage

a. Purpose. To document coverage along routes and airways, required by AT. Facilities maintenance personnel shall determine the extent of these evaluations which determine the overall radar facility coverage. Areas of intense clutter, poor target returns, or other potential problems identified in the inspection plan may be further evaluated to determine actual facility coverage. This check shall be accomplished using targets-of-opportunity with the final commissioning check done with a flight inspection aircraft.

b. Approved Procedures.

(1) Facilities maintenance personnel shall configure the primary radar in "circular polarization". The altitudes at which satisfactory radar coverage exists will be determined by flying the minimum altitude (not lower than MOCA) on airway centerline. The terminal arrival and departure routes and other areas of interest identified in the inspection plan will be flown at MOCA. Maintain course guidance by reference to AFIS, ground checkpoints, NAVAID signals, or radar vectors. Coverage verification using linear polarization may be checked at the discretion of the test engineer or, if a joint use site, by the DOD agency.

(2) Targets-of-Opportunity. Targets may consist of one or an assortment of aircraft returns on a particular airway, route or terminal radial. Targets used must be mode-C equipped so altitude information can be obtained. Scoring may be accomplished by either RDAS tools or manually. RDAS may be used to evaluate the track information of a selected (beacon code) target.

c. Evaluation. Facilities maintenance personnel shall determine if the facility coverage meets operational requirements.

215.3207 Fix/Map Accuracy.

a. Purpose. To verify all airways, routes, fixes, and runway centerlines on the video map display. Replacement map overlays, video maps, or digitally-generated maps do not require a flight inspection if facilities maintenance personnel can determine, using targets-of-opportunity, that the new map is accurate.

b. Approved Procedure. The flight inspector shall fly the minimum altitude where satisfactory radar coverage exists using NAVAID guidance, ground checkpoints, or AFIS to identify the airway, route, or fix. The procedure is the same whether using a flight inspection aircraft or targets-of-opportunity; facilities maintenance personnel compare reported aircraft position relative to the airway, route, or fix with the video map presentation. Similarly, verify runway centerline to video map alignment by observing landing and departing aircraft.

c. Evaluation. Compute the distance between the airway, route or fix, and the aircraft position, and apply the appropriate tolerance.

d. Radar Overlays. Flight inspection of radar map overlays used as a backup for a video map need not be accomplished, provided the overlay contains data which is identical to a video map display which has been satisfactorily inspected. Any data on an overlay that differs from the video map display shall be inspected before use. This applies to new or replacement map overlays.

215.3208 Fixed Target Identification.

a. Purpose. To identify prominent, primary broadband targets used for range and azimuth accuracy checks when they cannot be identified by other means. This check may be accomplished using targets-of-opportunity or flight inspection aircraft.

b. Approved Procedure. Facilities maintenance personnel will select identifiable features from a comparison of the ground clutter return and geographic maps (islands, mountain peaks, towers, etc.). They should direct the pilot to the PE return. If the pilot can identify and describe the ground target, and the target is a permanent feature, record the PE in the inspection report.

c. Evaluation. The pilot shall identify and record a description of the PE for inclusion in the inspection report.

215.3209 Surveillance Approaches.

a. Purpose. All ASR approaches shall be checked for accuracy and coverage by a flight inspection aircraft during commissioning inspections or any time a new approach procedure is developed. ASR approaches shall be checked on a periodic basis. Surveillance approaches shall be evaluated using surveillance type radar scopes. Conducting an ASR approach on a PAR display is not acceptable for flight inspection purposes. ASR approaches are not authorized using ATCRBS only, and the ATCRBS display should be offset.

(1) Approach to a Runway. The approach course shall coincide with the runway centerline extended and shall meet accuracy and coverage tolerances.

(2) Approach to an Airport. The approach course shall be aligned to the MAP as determined by procedures and facilities maintenance personnel. Helicopter-only final approach courses may be established to a MAP no farther than 2,600 ft from the center of the landing area.

b. Approved Procedure. The controller shall provide vectors for a 10-mile ASR final approach. The flight inspector shall fly at MVA until reaching the final approach segment. The final approach segment shall be flown 100 ft below all mandatory altitudes. The flight inspector shall evaluate the approach procedure, evaluate the aircraft position relative to the runway centerline extended/airport, and determine if a landing can be made without excessive maneuvering.

c. Evaluation. ASR approaches shall meet flight inspection tolerances or be canceled by appropriate NOTAM action. The cancellation of an ASR approach does not constitute a restriction on the radar facility. When MTI is required for an ASR approach, information shall be documented on the flight inspection report. The use of MTI does not constitute a facility restriction; however, ASR approaches which require MTI are NOT authorized when this feature is inoperative.

215.3210 Side-Lobe Suppression.

a. Purpose. To set transmitter power levels in the beacon SLS or ISLS antenna elements. The use of SLS/ISLS improves beacon performance, reducing or eliminating ring-around caused by the side lobes of the antenna pattern. ISLS also reduces false targets which are normally caused by close, vertical reflecting surfaces. This check may be accomplished using targets of opportunity or flight inspection aircraft.

b. Approved Procedure. Facilities maintenance personnel shall select azimuths to be checked in areas where side lobe problems have occurred in the past. Fly these radials at 1,000 ft above the radar site elevation to the coverage limits (normally line-of-sight). Facilities maintenance personnel shall adjust the SLS or ISLS power levels while observing beacon inner-range coverage. The power levels shall be adjusted for minimum ring-around and false target returns. After making final adjustments, ensure that inner range coverage is still satisfactory.

c. Evaluation. Facilities maintenance personnel shall evaluate SLS/ISLS performance.

215.3211 ATCRBS Modes and Codes

a. Purpose: To verify the proper decoding of ATCRBS reply pulses. Facilities maintenance personnel shall ensure that all modes and codes are verified by equipment test procedures before requesting flight inspection. Codes 7500, 7600, and 7700 should not be used due to the possibility of alarming other facilities.

b. Approved Procedure. Facilities maintenance personnel shall monitor the flight inspection aircraft transponder replies or targets-of-opportunity throughout the vertical coverage, airway, route, and terminal checks to verify correct altitude readout. During these tests, facilities maintenance personnel should request the flight inspection aircraft use different modes or codes to sample various modes and code trains. When targets-of-opportunity are used, ensure that the sample contains all modes interrogated and a sufficiently large sample of codes to ensure correct decoding of beacon replies.

c. Evaluation. Facilities maintenance personnel shall ensure the displayed transponder reading agrees with the aircraft transponder setting.

215.3212 ATCRBS Power Optimization

a. Purpose. To reduce over-interrogation, over-suppression, fruit, and false targets caused by reflections. Optimum ATCRBS power shall be the minimum ATCRBS power to meet operational requirements.

b. Approved Procedures. The aircraft shall be positioned to fly an arc in the vicinity of the vertical coverage radial or mutually agreed to reference radial at maximum distance. The aircraft altitude shall be 10,000 ft for ASR's and 30,000 ft for ARSR's, or as close to these altitudes as operational conditions allow. The beacon transmitter power shall be adjusted to the minimum value that produces a usable beacon reply or target. During this check, ensure that the aircraft transponder antenna is not shielded by aircraft. An ATCRBS power optimization shall be performed with a flight inspection aircraft following an increase in antenna tilt.

Vertical coverage as flown by a flight inspection aircraft or targets-of-opportunity shall be checked using the power level established in this paragraph. The beacon shall be commissioned at this power level, plus 1 dB.

c. Evaluation. Facilities maintenance personnel shall observe ATCRBS performance during the ATCRBS power optimization for a usable beacon reply.

NOTE: Although this test may be accomplished during the vertical coverage check, any changes made in beacon power, as a result of this test, will invalidate any portion of the flight inspection checked previously.

215.3213 ATCRBS GTC/STC Evaluation.

a. Purpose: To evaluate the ATCRBS GTC/STC setting. It shall be adjusted prior to the flight inspection and confirmed during the vertical and airway/route coverage checks. GTC/STC reduces the interrogator receiver gain, as the range to the station reduces, thereby reducing ring-around and false targets.

b. Approved Procedures.

(1) Facilities maintenance personnel shall observe the flight inspection aircraft target for ring-around, during the vertical coverage and airway/route coverage checks. Ring-around is an indication the GTC/STC is improperly adjusted.

(2) If false targets and/or ring-around persists, conduct a special target scoring check conducted solely for setting GTC/STC. This test requires a flight inspection aircraft configured in accordance with the Checklist in Paragraph 215.31. Position the aircraft on the vertical coverage radial or mutually agreed to reference radial, either inbound or outbound, at 10,000 ft AGL for ASR's and at 30,000 ft AGL for ARSR's or as close to these altitudes as operational conditions allow. Facilities maintenance personnel shall examine the received beacon signal during the entire radial (fringe to fringe). Correct GTC/STC setting is indicated by a fairly constant signal level over the entire radial.

(3) STC may be established during ground checks and evaluated with targets-of-opportunity by using RDAS tools or other software tools.

c. Evaluation. Facilities maintenance personnel shall observe the display for minimum false ATCRB's targets or ring-around.

215.3214 Communications. The purpose of this check is to evaluate VHF/UHF communications capability within the radar coverage area. The flight inspector shall check communications in accordance with Section 211, concurrent with the radar inspection.

215.3215 Standby Equipment. The purpose of this check is to evaluate the performance of standby equipment, and may be accomplished during pre-inspection testing using targets-of-opportunity. If standby equipment is available but not working, the flight inspector must be notified (see Paragraph 106.42). Some radar installations are engineered to meet reliability requirements by the use of redundant parallel units, instead of standby transmitters. Conduct flight inspection of these facilities while the system is operating in parallel. A separate check of each channel is not required. Some replacement radar units are collocated in the building with the primary radar and share the same waveguide and antenna during installation and checkout. In this case, the standby transmitter cannot be placed in operation without an extended facility shutdown. The pre-inspection testing of these systems shall thoroughly test all redundant and standby units to ensure they meet or exceed tolerances established on the flight inspected channel. A standby antenna (duplicate) may be installed at selected locations to provide continued radar service, in the event of antenna failure. The commissioning requirements for a standby antenna will be completed using the antenna change checklist.

215.3216 Standby Power. The purpose of this check is to evaluate radar performance on standby (engine generator) power and shall be conducted during pre-inspection testing. Results are satisfactory when the engine generator monitor equipment detects a power failure, starts the engine, and switches to the engine power without manual intervention. Conduct this test with a simulated power failure by manually switching out the incoming commercial power.

215.33 Minimum Safe Altitude Warning – (MSAW). Confirm radar identification and MSAW check in progress with the air traffic controller. Perform all checks in Normal/Normal transponder setting on an MSAW uninhibited beacon code.

(a) Approach Path Monitor (APM): Between the initial point 5 nm prior to AER or FAF, whichever is first, and the APM cut-off point, descend below the normal approach path into the approach path monitor area. MSAW will alert at or prior to the monitored area, depending on rate of descent. The APM cut-off point will be 1 – 2 nm prior to AER. For a circling only SIAP, the APM starts at 5 nm (or FAF) from the closest landing surface, and terminates 1 – 2 nm from the closest landing surface.

(b) General Terrain Map (GTM): Within 55 nm of the ASR, descend from MVA. Depending on rate of descent, MSAW will alert at or prior to the assigned bin altitude. Perform the GTM check at least 10 nm from airports that have an APM.

Ask the air traffic controller to verify that the MSAW alerted properly. Annotate on the DFL, Block 58 (Facility Status and Progress), any alert failure. Include location (e.g., JFK R-190/35, I-LAX ILS RWY 25L APM), transponder beacon code, and UTC time.

215.4 Analysis.

a. Testing Precautions. Radar inspections should not be attempted during heavy precipitation, temperature inversions, or other atmospheric conditions which change the coverage from normal. Whenever a system parameter does not meet tolerances and cannot be adjusted within a reasonable length of time, discontinue the flight inspection until the discrepancy is resolved. This does not preclude the continuation of tests in an effort to resolve the problems.

b. Evaluation. Usable radar coverage does not mean a usable target return on every scan at every azimuth and all usable altitudes. Missed targets can be caused by antenna lobing, line-of-sight, aircraft attitude, or antenna tilt. Therefore, isolated or non-recurring target misses are to be expected. If three or more consecutive misses are experienced, determine if a hole exists in the radiation pattern and determine its size. If holes or poor coverage are discovered, they must be evaluated to determine the effect on the operational requirements.

c. Probing. Holes in radar coverage are probed in a manner similar to VOR to TACAN. The following procedure may be used as a guide:

(1) Horizontal. Fly through the area of the suspected hole to determine the inner and outer boundaries. Vary the aircraft position every 10 degrees of radar azimuth until the lateral limits are established.

(2) Vertical. Fly through the center of the pattern established in the horizontal probing procedure at 1,000-foot increments to determine the upper and lower limits of the hole.

215.5 Tolerances

Figure 215-5
TOLERANCES

Parameter	Reference	Tolerance/Limit
Target Strengths		
Broadband/Reconstituted		
3—usable		Target leaves trail or persists from scan-to-scan without trail.
2—usable		Target shows each scan, remains on the display for at least 1/3 of the scan.
1—unusable		Weak target, barely visible, possible miss.
0—unusable		No visible target.
Narrowband		
1—usable		Visible target, satisfactory for ATC purposes.
0—unusable		No visible target, unsatisfactory for ATC.
Usable Target		Target which is not missed/ unusable on three or more consecutive scans.

Parameter	Reference	Tolerance/Limit
Orientation Maximum azimuth difference between actual and indicated for broadband and narrowband radar systems.	215.3201	$\pm 2^0$
Tilt	215.3202	No airborne tolerance.
Coverage		
Vertical - from inner to outer fringe	215.3204	Meets operational requirements at all altitudes.
Horizontal	215.3205	No tolerance.
Approaches, airways, arrival and departure routes, and fixes route/ procedure	215.3206	A usable target return shall be maintained along the entire route or throughout the procedure.
Accuracy		
Fix/map	215.3207	Within 3% of aircraft to antenna distance or 500' (1,000' for ATCRBS), whichever is greater.
Approaches	215.3209	
Straight-in		Within 500' of runway edge at MAP.
Circling		Within a radius of the MAP which is 3% of the aircraft to the antenna distance or 500', whichever is greater.
Altitude Readout	215.3211	± 125' of altitude displayed in the cockpit relative to 29.92 in Hg.
ATCRBS Power	215.3212	No tolerance
GTC/STC	215.3213	No tolerance
Communications	Section 211	See paragraph 211.5
Standby Equipment	215.3215	Meet same tolerances as main (dual channel) equipment. See paragraph 106.32.
Standby Power	215.3216	See paragraph 106.43

215.6 Documentation. The AF regional office of concern, or military equivalent, will compile and complete the facility inspection performance report. It will be a detailed accounting of all coverage data obtained using ground testing data, flight inspection aircraft, targets-of-opportunity, RDAS tools, and all flight inspection report information. The report submitted by the flight inspector shall contain only that information evaluated by the flight inspection crew. At joint use sites, a separate report will be published, under the direction of Air Combat Command and North American Aerospace Defense Command.

215.7 Facility Classification. The facility inspection performance report shall reflect a facility classification determined by the facility engineer in charge (or military equivalent). The flight inspection report shall reflect a facility classification jointly determined by the flight inspector and facilities maintenance personnel. Inaccuracies beyond established tolerances in range and azimuth for fix/map targets or surveillance approaches, will be the basis for the flight inspector to restrict the system or to request that it be removed from service until the condition is corrected.

SECTION 216. PRECISION APPROACH RADAR (PAR)

TABLE OF CONTENTS

SECTION 216. PRECISION APPROACH RADAR (PAR)

216.1 INTRODUCTION

a. This section provides instructions and performance criteria for certifying precision approach radars. The PAR is designed to provide an approach path for precise alignment and descent guidance to an aircraft on final approach to a specific runway through interpretation and oral instructions of a ground based controller.

b. PAR's provide a very high degree of resolution in terms of range, azimuth and elevation by radiating a narrow pulse and beam width. The pulsed beams are radiated along the predetermined descent path for an approximate range of 10 to 20 miles, and covers a sector of 20° in azimuth and up to 15° in elevation. Target information is displayed on an azimuth and elevation display. The displays must provide accurate information regarding an aircraft's range, azimuth, and elevation angle.

216.2 PREFLIGHT REQUIREMENTS

216.21 Facilities Maintenance Personnel. Prepare for flight inspection in accordance with the procedures outlined in Section 106.

216.22 Flight Personnel. The flight inspector will be in complete charge of the flight inspection. Flight personnel will prepare for the inspection in accordance with the procedure outlined in Section 106.

216.23 Special Equipment Requirements. Aircraft with altimeters calibrated according to FAR 43, appendix E, and FAR 91.170 or military specifications may be used for PAR flight checks. Theodolite or AFIS is required as follows:

a. During commissioning and/or after accident inspection of the glidepath angle and the lower safe angle.

b. Any time that more definitive analysis is required (e.g., engineering, research, development, etc.) of either the glidepath or the course azimuth.

216.24 Theodolite Procedures. The RTT or theodolite will be positioned as follows:

a. Glidepath Angle

(1) Place the theodolite as close to the runway as possible, forward of the RPI, to minimize or eliminate elevation differences between RPI (touchdown) and theodolite locations. The touchdown reflector is usually abeam the RPI, but not always. Therefore, the facility data sheet must be checked to establish the exact RPI location. Aircraft operations will dictate how close to the runway the theodolite can be located.

> **NOTE:** During the commissioning inspection of a new or relocated PAR, it is imperative that flight inspection personnel coordinate closely with the procedures specialist and installation personnel to locate the predetermined RPI.

(2) The distance the theodolite must be moved forward of the RPI to have the eye-piece aligned on the glidepath angle can be computed in the same manner as solving for ILS glidepath angles or tapeline altitudes. For example, a theodolite with the eye-piece set at 5 ft at a glidepath angle of 3.0° would be positioned 95.4 ft forward of the RPI.

b. Lower Safe Angle

(1) If the lower safe angle emanates from the same RPI as the glidepath, the theodolite position will be the position determined for the glidepath.

(2) If the lower safe angle emanates from a point other than the RPI for the glidepath, the theodolite will be relocated. Position and align the theodolite in accordance with instructions for glidepath angle using the lower safe angle RPI.

c. Course Alignment. Position the theodolite on runway centerline to evaluate course alignment at the runway threshold. Aircraft operations will dictate theodolite placement.

216.3 Flight Inspection Procedures. The flight inspection procedure for a PAR is divided into three parts:

a. Azimuth radar

b. Elevation radar

c. Overall system and controller performance (includes feature comparisons).

Commissioning inspections will provide engineering, maintenance, and operations personnel with sufficient data to determine system performance. Data obtained from the commissioning inspection will be the basis for the comparison of facility performance on subsequent inspections. Requirements for special checks will be determined by engineering, maintenance, and operations personnel, and will be conducted as specified in Section 104. Flight inspection is requried following an antenna change, change to the glide path angle, changes to reference (alignment) reflector height or placement, changes to cursor alignment voltages or settings, and any other action which will change the azimuth or elevation alignment.

216.31 Checklists. The checklists below are to be used for the identified equipment. If the equipment to be inspected is different, the basic requirements for a "generic" PAR shall be used and additional runs performed to check any special features specified by facility engineering or operations. At locations where approaches to more than one runway are provided, checks will be accomplished for each runway on commissioning inspections. Periodicity of checks shall be accomplished in accordance with Section 105, alternating runways, assuring that all runways/SIAP's that are associated with the PAR system are checked at least once each 540 days. The periodic shall be considered complete each time the periodic checklist is complete and the SECTION 214 SIAP check is accomplished for the runway being inspected.

Legend for Checklists

AC - Antenna Change

A Cursor - The cursor defining the normal glide angle

ALS - Automatic Landing Subsystem

B Cursor - The cursor defining the lower safe limit

C - Commissioning

CFAR - Constant False Alarm Rate

DBC - Database Change (may be software or firmware

P - Periodic

a. GENERIC PAR (FPN-40, FPN-62/63, MPN-14, TPN-18, TPN-44)

This family of radar is characterized by mechanically scanned (moving) azimuth and elevation antennas. Displayed targets are not computer enhanced. The PAR may be part of a larger system containing an ASR.

Type Check	Inspection				CURSOR	Measurements Required								
	C	AC AZ	AC EL	P		Obstacle Clearance	Coverage	Range Accuracy	MTI/ MTD	Angle Coinci- dence	Alignment AZ	Alignment GP	Deviation Accuracy	CP/ LP
Approach #1	X			X	A	X	X	X	X	X	X	X	X	X
Approach #2	X		X	X	B	X	X							
Lateral Coverage	(1)	(1)	(1)		A	X	X							
Azimuth Only	X	X				X	X				X	X		
Standby Transmitter	X			(2)			X	X	X		X	X		X
Standby Power	X				A		X					X		
Alternate Angle	X		X		A		X					X		
Lights	X			X			X							
Comm	X			X			X							

(1) Maintenance request

(2) Periodic inspections attempt to check the channel not checked on the previous inspection.

b. GPN-22, TPN-25

These radars, which differ only in physical configuration and associated equipment, have an electrically scanned (non-moving) antenna. Displayed targets are computer generated. The system uses circular polarization only. The system consists of dual transmitters and dual receivers/processors with EPROM cards. In normal use, selection of these units is automatic; for flight inspection, they must be manually selected at the radar site.

Type Check	Inspection					Facility Config	CHANNEL (5c)	CURSOR	Measurements Required							
	C (6, 7)	AC AZ	AC EL	P	DBC (7)				Obstacle Clearance	Coverage (2)	Range Accuracy	MTI/ MTD	Angle Coinci-dence	Alignment AZ	Alignment GP	Deviation Accuracy
Approach #1	X	X	X	X	X	(3)	A	A	X	X	X	X	X	X	X	X
Approach #2	X				X	(4)	A	A	X	X	X	X	X	X	X	X
Approach #3	X					(3)	B	A	X	X	X	X	X	X	X	X
Approach #4	X			X		(3)	B	B	X	X						
Approach #5	X				X	(3)	A	B	X	X						
Azimuth Only	X	X				(3)	A		X	X						
Lateral Coverage	(1)	(1)	(1)			(3)	A	A	X	X						
Standby Transmitter (5)	X			5a		(3)	A			X	X	X				
Standby Power (8)	X					(3)	A	A		X					X	
Alternate Angle	X		X			(3)	A	A		X					X	
Lights	X			X						X						
Comm	X			X						X						

NOTES:

(1) Maintenance Request

(2) Normal Coverage is 20 nm. Establish coverage limits during commissioning (or at maintenance request) by flying a 20-mile final approach; thereafter, controller/maintenance personnel shall monitor coverage on a daily basis using targets of opportunity.

(3) Track Mode - NORMAL Close Control FTC-ON MTI - COHERENT

(4) Track Mode - BACKUP Scan Only FTC-OFF MTI-NON-COHERENT

(5) Commissioning requirements for standby equipment (consisting of a complete separate channel) can be completed by flying Runs 1, 2, and 5 to any one of the runways served. If standby equipment is only a separate transmitter, fly Run 1 from 20 nm to satisfy commissioning requirements.

a. Check both receivers/processors during a periodic check.

b. It is only necessary to check the operating radar transmitter and database during a periodic check.

c. A-Channel/B-Channel refers to which receiver/processor is on-line.

	C	P
Radar Receivers/Processors	X	X (5a)
Radar Transmitters	X	X (5b)
Database	X	X (5b)

(6) Parallel Runways. If one reference reflector and a common glidepath angle are used for parallel runways, only 5 runs are required for commissioning. Fly approaches # 1,# 2, and #3 on the left runway, #4 and #5 on the right runway and reverse the order for the opposite end. If each runway has a separate reference reflector and/or angle, fly approaches #1,# 2, and #3 on the left runway, #1, #4, and #5 on the right runway and reverse the order for the opposite end.

(7) Each data base version requires a flight inspection prior to operational use in order to verify that the data base data can be loaded into the PAR computer and that the data produces the correct results. Documentation required for commissioning and equipment/database changes:

a. Transmitter Power
b. Receiver sensitivity in normal, Coherent MTI, and Non-Coherent MTI
c. Firmware Version Numbers
d. Clutter reject setting (if required for approaches).
e. Digital MTI baseline limiting settings
f. Usable radar range on 20 nm radar

(8) Evaluate the operation on standby power during any of Runs 1, 3, 4, or 5.

c. TPN-22

The AN/TPN-22 Precision Approach Radar (PAR) is a transportable, computerized, pencil beam, 3-dimensional radar. The system is a track-while-scan radar. The radar uses phase and frequency scanning techniques with an electronically steered beam antenna array. The system uses circular polarization only. The system has additional capabilities requiring interface with specialized aircraft equipment; these features are not subject to flight inspection.

Type Check	Inspection				ALS PAR Mode	Video Mode	CURSOR	Measurements Required							
	C	AC	P	DBC				Obstacle Clearance	Coverage	Range Accuracy	MTI/ MTD	Angle Coinci-dence	Alignment AZ	Alignment GP	Deviation Accuracy
Approach #1	X	X	X	X	Auto (2)	Linear	A	X	X, (5)	X	X	X	X	X	X
Approach #2	X	X	X	X	Auto (2)	Linear	B	X	X, (5)					X	
Approach #3	X	X	X	X	Auto	MTI	A	X	X, (5)	X	X	X	X	X	X
Approach #4	X	X	X	X	Auto	MTI	B	X	X, (5)					X	
Approach #5	X	X		X	Man	CFAR	A	X	X, (5)	X	X	X	X	X	X
Approach #6	X	X		X	Man	CFAR & MTI	A	X	X, (5)					X	
Azimuth Only	X				Auto (2)	Linear		X	X, (5)						
Lateral Coverage	(1)	(1)					A	X	X						
Alternate Touchdown #1 (4)	X		X	X	Auto (2)	Linear	A		X	X				X	
Alternate Touchdown #2 (4)	X		X	X	Man	Linear	A		X	X				X	
Alternate Touchdown #3 (4)	X	X	X	X	Man	Linear	B		X	X				X	
Standby Power (3)	X				Auto (2)	Linear	A		X						
Lights	X		X						X						
Comm	X		X						X						

NOTES:

1. Maintenance request.
2. A periodic check shall be considered complete if Auto-Mode is inoperative. Note the condition on the flight inspection report. The PAR shall be considered as "Restricted" and authorized for use in Manual-Mode only.
3. IF EQUIPPED, standby power should be performed on the last run due to the extensive time required to reload the software and data.
4. Alternate touch down (TD) points using the same glide angle may be available.
5. Request usable distance from controller on each approach.

TPN-22 CONTROLLER INSTRUCTIONS

1. **<u>Auto-Mode</u>:** Controllers shall configure the Auto-Mode as follows: Load the PAR Program, OPS software, and System Initialization (SI) data and configure the Control and Status Panel per Table 1. Verify that the system is in Fine Alignment. If the system is NOT in or CANNOT maintain fine alignment, AUTO-MODE run will NOT be attempted for this Touchdown Point.

2. **<u>Manual Mode</u>:** Controllers shall configure Manual-Mode as follows: Take the actions necessary to perform a UNIT OFF, ONLY on the MMD being used for the flight check. Enter the Touchdown Parameter Data in this MMD's FC Basic Mode and configure the Control and Status Panel per Table 1.

TABLE 1

CONTROL AND STATUS PANEL (CSAP) AUTO/MANUAL MODE CONFIGURATION		
INDICATOR/SWITCH	**AUTO MODE**	**MANUAL MODE**
AZIMUTH SECTOR	46°	46°
ALS PAR MODES		
AUTO	X	
MANUAL		X

3. Document the following information (items a – c) in the Tables provided below for commissioning and periodic inspections, hardware, software, or firmware changes.

(a) Document the Operational Software Program Name, Part, Number, Version, Serial Number, and Build Date.

Sample program inventory sheet:

PROGRAM NAME	PART #	VERSION #	SERIAL #	BUILD DATE
PAR PROGRAM	N/A	V5R6	102	1/18/94
PAR PROGRAM	N/A	V5R6	103	1/18/94
CCS OPS SOFTWARE	111440	L-4	1000	7/25/94
CCS OPS SOFTWARE	111440	L-4	1001	7/25/94
CCS OPS SOFTWARE	111440	L-4	1002	7/25/94
CCS OPS SOFTWARE	111440	L-4	1003	7/25/94
CCS OPS SOFTWARE	111440	L-4	1004	7/25/94
CCS OPS SOFTWARE	111440	L-4	1005	7/25/94
CCS OPS SOFTWARE	111440	L-4	1006	7/25/94
CCS OPS SOFTWARE	111440	L-4	1007	7/25/94
CCS OPS SOFTWARE	111440	L-4	1008	7/25/94
CCS OPS SOFTWARE	111440	L-4	1009	7/25/94
PDS NVS FIRMWARE	11420	A-4	N/A	6/17/90
S.I. DATA	N/A	N/A	N/A	11/16/95
S.I. DATA	N/A	N/A	N/A	11/16/95

(b) Record the Useable Radar Range for each approach. Report results to the flight inspector.

(c) The AN/TPN-22 will be in constant Fine Alignment for ALL Auto-Mode runs. The Fine Alignment Corner Reflector error numbers for EACH touchdown point will be recorded in the table below. The Fine Alignment Data shall be recorded from the FC MT Mode Corner Reflector Error Display. Verify for each touchdown point that the value recorded is within the tolerance specified. The data shall be provided to the flight inspector during the inbound run for each approach to the desired touchdown point.

AUTO MODE CORNER REFLECTOR FINE ALIGNMENT DATA

TOUCHDOWN POINT 1				**TOUCHDOWN POINT 2**			
Parameter	Tolerance	Measured		Parameter	Tolerance	Measured	
		CR1	CR2			CR 1	CR 2
AZ Deg	± 25°			AZ Deg	± 25°		
EL Deg	± 25°			EL Deg	± 25°		
Range	± 43 ft			Range	± 43 ft		
TOUCHDOWN POINT 3				**TOUCHDOWN POINT 4**			
Parameter	Tolerance	Measured		Parameter	Tolerance	Measured	
		CR1	CR2			CR1	CR2
AZ Deg	± 25°			AZ Deg	± 25°		
EL Deg	± 25°			EL Deg	± 25°		
Range	± 43 ft			Range	± 43 ft		

d. MPN-25, TPN-31, FPN-67 (U.S. Army), GCA-2000

The MPN-25 (USAF)/GCA 2000 PAR produces computer-generated targets but has no special inspection requirements. It does not have conventional MTI capability. The system does not have controllable antenna polarization but has RAIN MODE that performs the same function as Circular Polarization (CP) and Clear Mode that performs the same function as Linear Polarization (LP).

Type Check	Inspection					Facility Config (2)	CURSOR	Measurements Required							
	C	AC AZ	AC EL	P	DBC			Obstacle Clearance	Cvg	Range Accuracy	Angle Coinci-dence	Alignment AZ	Alignment GP	Deviation Accuracy	Rain/ Clear
Normal Approach	X			X	X	Rain Mode	A	X	X	X	X	X	X	X	X
Lower Safe	X		X	X	X	Clear Mode	B	X	X						
Lateral Coverage	(1)	(1)	(1)			Clear Mode	A	X	X						
Azimuth Only	X	X				Clear Mode		X	X			X	X		
Standby Transmitter	X								X	X					
Standby Power	X						A		X				X		
Alternate Angle	X		X		X		A		X				X		
Lights	X			X					X						
Comm	X			X					X						

NOTES:
1. Maintenance Request
2. Not controllable in TPN-31 and FPN-67.

216.32 Detailed Procedures

a. General. The basic method for checking a PAR is to have the controller vector the aircraft and provide guidance instructions to the flight inspector for evaluation of the facility.

b. Maintenance/engineering personnel in cooperation with operations personnel will spot check all features available on the PAR and advise the flight inspector if any of these features are not available or are unusable. These features include STC, FTC, CP, and CFAR. On computer-generated radars, additional features include: non-coherent MTI (rain reject), ACQ (high and low), track mode (normal and backup), STC (high and low), and power (high and low). PAR checks will be made using circular polarization (CP) if available, and spot checks of the facility will be made using linear polarization. On some computer-generated radars, CP is a fixed feature and is used at all times.

c. Operational scopes will be used on all flight checks for target grading and guidance information. Data taken from the operational scopes shall determine whether or not the facility meets the prescribed tolerances.

d. Suitability and approval of approach procedures previously developed by the procedures specialist are based on the flight check of the particular facility.

216.3201 Course Alignment and Coverage (Azimuth). Any of the following methods may be used:

a. AFIS Method. This is the preferred method. Use the procedures in the appropriate AFIS equipment handbook.

b. Visual Method. To check for course alignment, proceed in-bound at pattern/intercept altitude from approximately 10 to 12 miles from the runway and, when on-course and path, descend at a normal glidepath angle with the final controller furnishing information to enable the flight inspector to fly on the centerline azimuth. This information is to be given as "left," "right," or "on-course." Range should be given at least every mile. The flight inspector will determine, by visual reference to the runway, if the centerline is straight and if it coincides with the runway centerline extended.

c. Theodolite Method. At some locations, it may be necessary to use a theodolite to supplement the pilot's observations, especially when the runway is extremely wide or poorly defined by surrounding terrain. Proceed in-bound at pattern/intercept altitude from 10 to 12 miles from the field. Have the final controller furnish information as to the aircraft's position relative to runway centerline. The theodolite operator will continuously track the aircraft and inform the pilot of the aircraft position relative to runway centerline.

216.32011 Azimuth Only Procedures. Some facilities have “AZ ONLY” or “PAR w/o GS” procedures published for use during outages of the elevation portion. Procedurally, the obstacle clearance area of the PAR is used and non-precision Required Obstacle Clearance (ROC) applied. An “AZ ONLY” approach may therefore have a lower MDA than an ASR approach to the same runway because the ASR obstacle clearance area is larger and may contain higher obstacles. For a PAR with “w/o GS” procedure, the procedural altitudes shall be maintained in all but the final segment. For the final segment, upon reaching the FAF inbound, descend at a rate of approximately 400 ft per mile to an altitude of 100 ft below the lowest MDA and maintain this altitude to the threshold. Ensure radar coverage and obstacle clearance. Alignment should be measured at threshold; this requirement may be satisfied during the normal PAR approach.

216.3202 Course Deviation Accuracy. While flying inbound on runway centerline extended, deviations to the right or left of centerline should be made with attention directed as to how far the aircraft must move off centerline before the controller notices movement. The controller needs only to state - slightly left (or right) of centerline.

216.3203 Range Accuracy. Check the accuracy of the range information, both video and fixed, by comparison with the AFIS or DME. Checkpoints such as the outer marker or VOR are excellent; however, any well surveyed checkpoint is satisfactory, provided its distance from the field can be established. All ranges are measured in nautical miles from touchdown. In areas where there are no ground checkpoints or good electronic means of accurately measuring distance from the field, such as DME, this check may be omitted. Normally, two checkpoints, one at 5 to 10 miles and one at 1/2 mile, are sufficient for checking range accuracy. Range accuracy checks of azimuth and elevation radar normally will be made simultaneously. (See Paragraph 216.3204, Note.)

216.3204 Usable Distance. The check for usable distance or maximum range, may be made while proceeding in-bound from the limit of the radar coverage during the course alignment check by having the controller give the mileage when the aircraft is first displayed. The new radars have ranges of 15 to 20 miles, but because of small aircraft size, less coverage can be expected. Azimuth and elevation coverage can be checked simultaneously. Coverage of those PAR's which have coverage capabilities beyond 10 nm should be checked at the minimum vectoring altitude to the coverage capabilities of the radar. Coverage should be checked using alternately normal and MTI radar. Periodic coverage checks need to be made only in the area of operational use.

NOTE: Mileage information given by the radar operator should be the mileage from the touchdown point to the target aircraft. In case erroneous mileage information is given, the flight inspector should inquire if the range information obtained from the scope has been corrected to compensate for the distance from the antenna to the RPI (touch-down point).

216.32041 Coverage (Lateral). The lateral coverage of the PAR may be determined by flying perpendicular to the course. Lateral position of the aircraft shall be determined by AFIS, theodolite, or large scale map. Altitude and distance will be determined by engineering/maintenance personnel. The controller will indicate when he/she obtains and loses radar contact.

216.3205 Moving Target Indicator (MTI)/Moving Target Detector (MTD). Blind speeds for PAR systems are usually quite high due to the high pulse repetition frequency (PRF) required for good target definition. It may be quite difficult to perform an MTI/MTD check with certain types of small aircraft due to speed limitations. This check can be omitted if the speed range required is impossible to attain. The check can be performed at a later date when a faster aircraft is available. An airspeed notch of as much as plus or minus 20 knots may exist around the computed blind speed.

a. During the commissioning inspection, the MTI/MTD feature will be checked to determine if there are any blind speeds at which it is impossible to maintain continuous radar contact. On subsequent inspections, MTI/MTD needs to be checked only when requested by maintenance or operations. Maintenance personnel will provide the precomputed blind speed for the radar. Determine the airspeed which will give the required ground speed. Fly in-bound from approximately 10 miles (ensure that MTI is gated beyond 10 miles) while varying the air speed slightly above and below the previously computed airspeed. Note the speed range within which a reduction of target brilliance occurs. Close coordination between the controller and the flight inspector is necessary to determine the speed at which MTI/MTD causes the greatest effect.

b. When MTI/MTD is required on the final approach, this information shall be noted on the flight inspection report. The requirements for MTI do not constitute a facility restriction. Both azimuth and elevation MTI/MTD normally will be checked at the same time.

c. On radars with computer generated displays, the normal mode of operation is to use the synthetically generated symbols for approaches. The normal radar (scan) mode must be checked to determine its usability for approaches. If unusable for approaches, determine the inner limit of usability so that the feature can be used for control and traffic information outside of that point. Document the results of the scan-mode inspection in the Remarks section. If the scan mode is not usable for approaches, it will not cause a facility restriction but must be documented on the Facility Data Sheet.

216.3206 Glidepath Alignment. During the glidepath alignment check, it is necessary to determine the glidepath angle and the straightness of the glidepath centerline. Some new military PAR's have the capability to provide controller selected multiple glidepaths. For these radars, all published angles shall be inspected prior to use; for periodic inspections, only the lowest angle must be evaluated.

a. AFIS Methods. PAR glide slope angle may be determined by AFIS.

b. Theodolite Method. Position the theodolite according to instructions in paragraph 216.24. Communications on a common frequency are essential for the theodolite operator, final controller, and flight inspector. After communications have been established at all three locations, the aircraft should proceed in-bound from a point approximately 12 miles from touchdown and at the pattern altitude until the final controller advises that the aircraft is on the glidepath. A descent is then commenced, maintaining the aircraft as nearly on the centerline or glidepath as possible by using the information furnished by the controller.

The pilot should maintain as constant an attitude as possible throughout the approach. Information should be given in terms of "above," "below," or "on glidepath." The theodolite operator will track the aircraft from the start of the in-bound run, maintaining the horizontal cross-hair exactly on the aircraft as it descends on the glidepath. As the aircraft proceeds in-bound, the theodolite operator should listen carefully to the glidepath information issued by the controller and have an assistant record the angle each time the controller calls the aircraft "on glidepath." Do not record calls taken inside of decision height. These angle readings should then be averaged to determine the actual glidepath angle.

c. Precision Range Mark Method. When it is impractical to check the glidepath alignment using the above methods, it is permissible to use the radar to determine the distance of the aircraft from the touchdown point. Obviously, any range errors present in the PAR will cause a corresponding error when measuring the glide slope angle. When making this check, calculate the altitude for the published/desired glidepath angle at the 6-, 5-, 4-, 3-, 2-, and 1-mile range marks. Instruct the PAR controller to give precise "on path" calls and the precise point at which the radar return crosses the range marks. By comparing the actual aircraft altitude at the exact point on glidepath with the calculated altitude, it can be determined that the glidepath is at the published/desired angle. Although there is a small amount of altimeter lag when proceeding down the glidepath using this method, it is negligible and can be disregarded. The straightness of the glidepath can be ascertained concurrently with the alignment check.

An alternative method is to fly a descending run on the glidepath and note the difference in altitude between range marks. It is necessary that the controller provide range information each time a path call is given. The glidepath angle can then be determined as indicated in Formula 302.8B, using on-path calls at the measurement points.

216.32061 Application of Angle Tolerances. Prior to the commissioning inspection of PAR's, operational personnel must determine the "desired" angle to which the PAR is to be commissioned. This angle is determined by obstacle clearance criteria and operational use requirements.

The obstacle clearance criteria allows for operational deviation (periodic angle tolerance) of two tenths of a degree from the commissioned angle. It is imperative that the reported commissioned angle be the angle for which obstacle clearance and operational criteria has been applied. The desired angle, the computed angle, and the commissioned angle are actually the same.

The allowable periodic deviation of .2° is applied to the desired/computed angle and not the angle found during commissioning inspections. Because the periodic tolerance of .2° is applied to the commissioned angle, operations/maintenance personnel must determine the acceptability of a facility which will require the application of an imbalanced periodic tolerance. An example of this situation is as follows: Desired/commissioned angle = 3.00°, angle found during commissioning = 2.90°, allowable deviation = 3.00 ± .2° or 2.8 to 3.2°.

216.3207 PAR Coincidence with Other Guidance. Coincidence of the azimuths and glidepaths of the PAR and ILS/MLS/VGSI is essential to preclude pilot confusion from different indications of the ILS/MLS/VGSI and PAR. Coincidence may be checked using the AFIS, theodolite, precision range mark procedure, or a microamp comparison with the ILS/MLS/VGSI. If any doubt exists as to glide angle coincidence, the theodolite or AFIS shall be used. Perform a PAR approach as directed by the final controller and monitor the approach using the ILS/MLS/VGSI. Coincidence probably will not be maintained from Point "B" to touchdown due to the characteristics of the ILS glide slope inside Point "B." Areas of non-coincidence of the azimuths and glide-paths should be noted.

216.3208 Lower Safe Limit Alignment. The lower safe limit shall be checked as follows:

a. Fly in-bound 5 to 7 miles from the runway on the lower safe limit line and maintain "on-path" at the controller's direction. Maintain "on path" position to the runway, or until it becomes obvious that a pull-up is necessary to avoid obstacles. By flying the lower safe limit line, the aircraft should clear all obstacles prior to passing the runway threshold.

b. Scopes which do not have the lower safe limit line portrayed shall be checked in the same manner as above. The controller will supply information to the flight inspector so that he can fly the lower safe limit altitudes (below which a missed approach would be necessary), and be clear of obstacles prior to passing the runway threshold.

The lower safe limit angle is normally 0.5° less than the glidepath angle. During the commissioning flight checks, the lower safe limit angle shall be established in the same manner as the glide slope angle (see paragraph 216.3206). Verification of the angle on subsequent checks is not necessary unless requested by maintenance; all that is required is that satisfactory obstacle clearance is provided while flying the lower safe limit line/altitude as described above.

216.3209 Lighting Systems. Lights shall be inspected in accordance with applicable sections of this manual.

216.3210 Communications. During commissioning inspections, check all required frequencies from the final controller position. Evaluate both primary and standby radios for clarity and coverage. These checks may be done within or beyond the radar service area.

216.3211 Standby Equipment. If dual channel is installed, the standby channel will be spot checked to ensure that it is functioning in a manner equal to the primary equipment. For periodic inspections, review the previous flight inspection report and attempt to check the channel not checked on the previous inspection.

216.3212 Standby Power. Standby power shall be inspected in accordance with Section 106.43 of this manual. Standby power can be checked on any approach required by the Paragraph 216.31 Checklist. It is not necessary to duplicate a run solely to check standby power.

216.4 ANALYSIS. A flight inspection of a ground radar facility always uses the services of the ground controllers, maintenance, and/or engineering personnel because of the inherent and unique characteristics of the entire system.

The flight inspector is responsible for determining that the PAR conforms to the specified tolerances. Any discrepancies found which could be attributable to controller technique should be brought to the attention of the ground supervisory personnel.

216.5 TOLERANCES. All precision approach radars shall meet the tolerances set forth below for an unrestricted classification. Classification of the facility based on flight inspection results is the responsibility of the flight inspector.

PARAMETER	REF. PARA.	INSPECTION C	INSPECTION P	TOLERANCE/LIMIT
Azimuth Course Alignment	216.3201	X	X	The greater of 30 ft or 0.2° referenced to runway centerline at threshold
Course Deviation Accuracy	216.3202	X	X	Target presentation shall be coincident with aircraft position
Range Accuracy	216.3203	X	X	± 2% of true range
Usable Distance AZ and EL	216.3204	X	X	Minimum of 7.5 nm from touchdown
Lateral Coverage	216.32041	X	X	± 10° from procedural C/L
Moving Target Indicator (MTI)/ Moving Target Detector (MTD)	216.3205	X	X	Shall not cause loss of usable target at other than blind speed
Glide Path Alignment (Angle)	216.3206	X		0.1° of published angle
			X	0.2° of published angle
PAR/ILS/MLS/VGSI Comparison of “as-found” PAR angle with published ILS/MLS/VGSI Angle	216.3207	X	X	0.2°
Lower Safe Limit Alignment (Angle)	216.3208	X	X	Clearance from all obstacles from GSI to runway threshold
Standby Equipment	216.3211	X	X	Same as primary .3202

216.6 ADJUSTMENTS. See paragraph 106.45.

SECTION 217. INSTRUMENT LANDING SYSTEM (ILS)

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Paragraphs	***Title***	***Pages***

SECTION 217. INSTRUMENT LANDING SYSTEM (ILS)

217.1 INTRODUCTION. This section provides instructions and performance criteria for certifying localizer and glidepath which operate in the VHF and UHF band. Flight inspection of the associated facilities used as integral parts of the instrument landing system shall be accomplished in accordance with instructions and criteria contained in their respective sections of this manual or in other appropriate documents.

a. The two basic types of localizers are single frequency and dual frequency. Localizers are normally sited along the extended centerline of the runway; however, some are offset from the extended centerline. Localizer type directional aids (LDA) may be located at various positions about the runway.

b. Another type of facility which provides azimuth guidance is the simplified directional facility (SDF). The two basic types of SDF facilities are the null reference type and the phase reference type.

c. The three basic image array glide slope systems are null reference, sideband reference, and capture effect. The two non-image array systems are the endfire and the waveguide.

d. Flight inspection techniques using the FAA automated flight inspection system (AFIS) are detailed in other directives. Where AFIS is available, these techniques shall be used to accomplish the approved procedures in this section.

217.11 ILS Zones and Points. ILS zones and points are defined in Section 301 and are illustrated in Figure 217-1.

217.12 ILS Facilities Used for Higher Category Service. Some ILS's are used to support higher than normal category of service. These systems will be identified in the Facility Data Base. They shall be evaluated fully to the standards and tolerances of the higher category. When a facility is initially identified for use at the higher category, the Flight Inspection Technical Support Branch shall research the inspection history to determine which checks are required to bring the system to the higher standard.

217.2 PREFLIGHT REQUIREMENTS

217.21 Facilities Maintenance Personnel. Prepare for flight inspection in accordance with paragraph 106.31.

217.22 Flight Personnel. Prepare for flight inspection in accordance with paragraph 106.32.

217.23 Special Equipment Requirements. AFIS is the standard system for ILS flight inspection and shall be used for all commissioning checks except where RTT is required to support military contingencies. RTT may be used for all other checks; however, it should not be used solely to bypass the need for facility data of sufficient accuracy to support AFIS. AFIS or RTT shall be used for all categorization or After-Accident checks. Except as limited by this paragraph, a standard theodolite may be used as indicated below:

a. CAT I/II/III Localizer periodic or special checks

b. CAT I Glide Slope periodic or special checks

c. CAT II/III Glide Slope checks not requiring determination of actual path angle or path structure**.**

217.24 Glidepath Origination Point. The glidepath origination point is required for AFIS-equipped aircraft. For image array glide slopes, engineering personnel shall supply the latitude/ longitude of the antenna mast and the mean sea level elevation of the glidepath origination point. For non-image arrays, engineering personnel shall supply the latitude, longitude, and mean sea level altitude of the glidepath origination point.

217.241 Angular Reference. With the exception of Tilt Checks IAW Paragraph 217.3309, which are referenced to localizer deflection, all glide slope offset angular measurements are referenced to a point on a localizer centerline abeam the glide slope origination point.

ILS ZONES AND POINTS

Figure 217-1A(1)

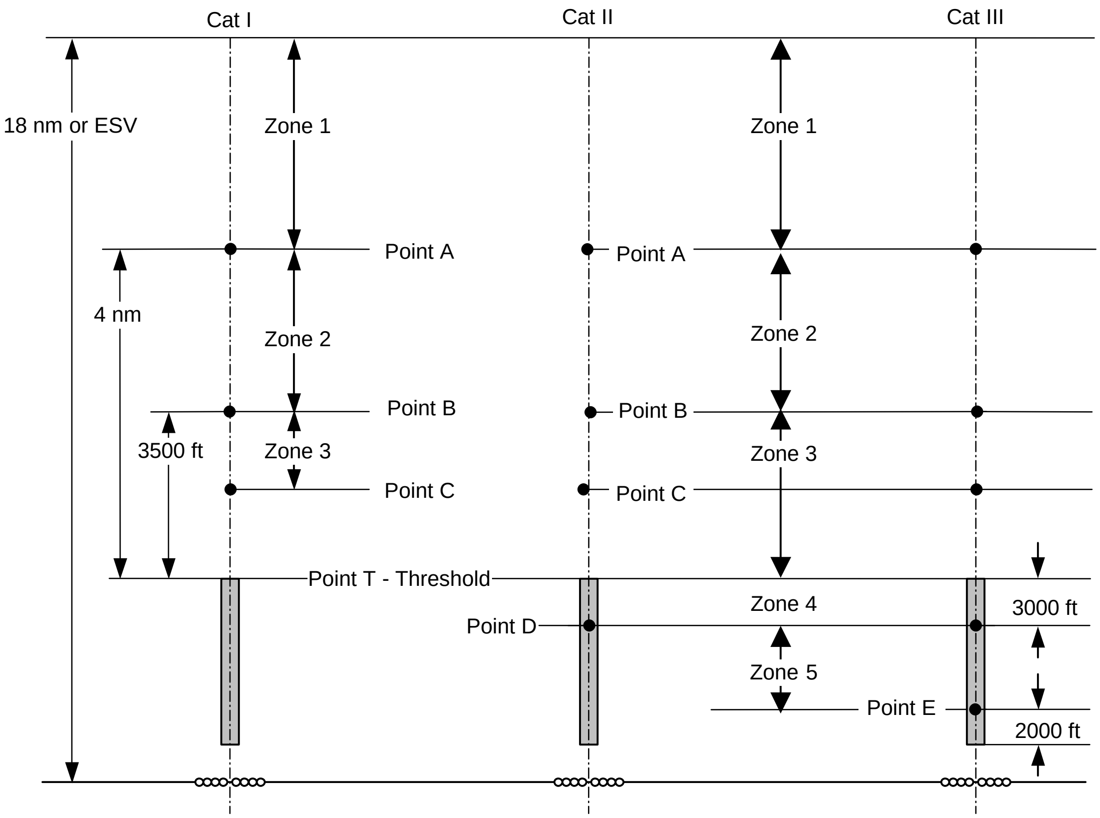


Figure 217-1A(2)
TYPICAL OFFSET ILS

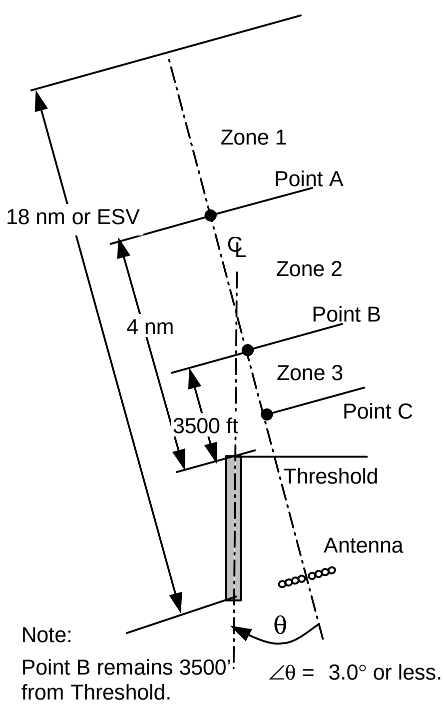
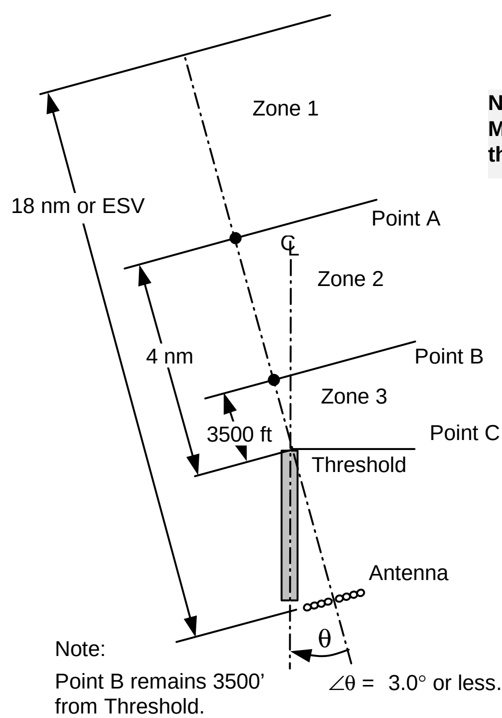


Figure 217-1A(3)
TYPICAL OFFSET LOCALIZER



NOTE: Point C is the MAP and may be prior to threshold

LDA CONFIGURATIONS

Figure 217-1B(1)

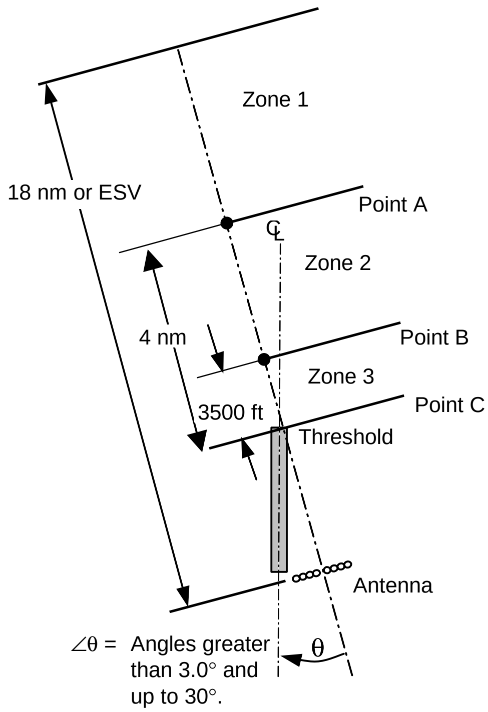


Figure 217-1B(2)

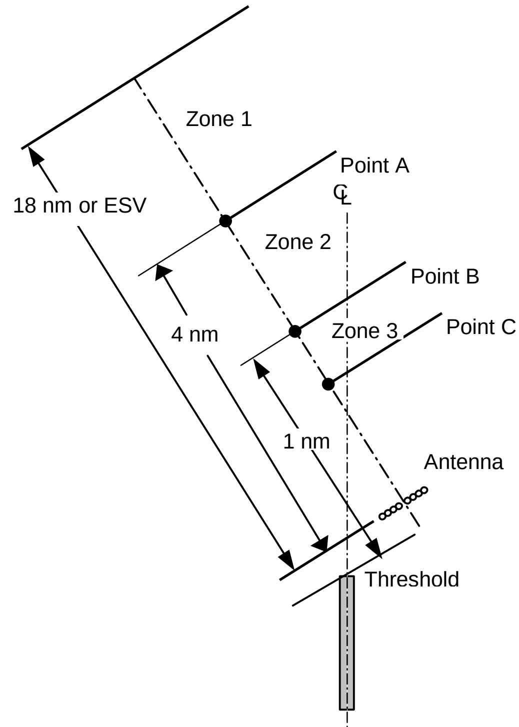


Figure 217-1B(3)
Back Course Localizer/SDF

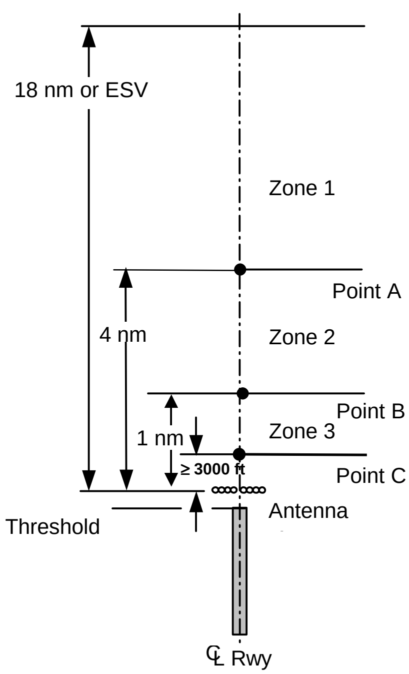
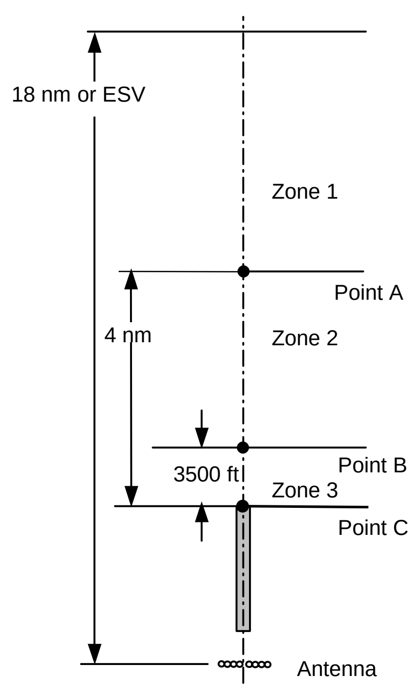


Figure 217-1B(4)
Localizer/SDF Approach

NOTE: Point C is the MAP and may be prior to threshold



217.25 Theodolite Procedures. The RTT or theodolite will be positioned in accordance with the following criteria:

a. Glide Slope Image Array Systems

(1) First Method

(a) Through engineering survey data or by use of the theodolite itself, determine the difference in elevation, to the nearest inch, between the ground plane at the base of the antenna mast and the center of the runway opposite the mast. This can be accomplished by sighting with the theodolite to a surveyor's marker pole placed at the center of the runway opposite the mast or vice versa. If the crown of the runway is higher than the ground level at the antenna, the difference is treated as a minus value; if lower, the difference is a plus value. If the elevation difference determined above (minus value only) provides a comfortable eyepiece height, the theodolite may be positioned at that height at the base of the antenna mast and steps (b) through (e) disregarded.

NOTE: Where the elevation of the base of the antenna mast is more than 62 inches lower than the center of the runway opposite the antenna, alternate procedures to theodolite positioning should be considered. One such alternate is to apply steps (a) through (e) using an image position for the antenna base on the side of the runway opposite the facility.

(b) Place the theodolite at the base of the glide slope antenna mast with the eyepiece 62 inches above the ground.

(c) Sight along a line between the antenna mast and the center of the runway threshold with the eyepiece set at the commissioned or desired vertical angle.

(d) Using a marker pole, determine the position on the ground along the line in step (c) which is exactly 124 inches, plus or minus the elevation difference obtained from step (a). For example, if the runway is higher, subtract the elevation difference from 124 inches, if lower, add the elevation difference to 124 inches.

(e) Establish the eyepiece height of the theodolite at 62 inches with the commissioned angle (or desired vertical angle) of the glidepath set in the theodolite.

(2) Second Method. This method applies to locations where the transverse slope between the glide slope antenna base and the runway edge is irregular, e.g., pedestal runway. The determination of the irregular transverse slope and use of this procedure shall be made by engineering/ installation personnel.

(a) Place the theodolite at the base of the glide slope antenna mast with the eyepiece 62 inches above the ground.

(b) Sight along a line between the glide slope antenna mast and the center of the runway threshold with the eyepiece set at the commissioned angle (or desired vertical angle).

(c) Using a marker pole, determine the position on the ground where the optical angle passes through the 124-inch point of the marker pole. Mark this position for future use.

(d) This is the correct position for placing the theodolite with the eyepiece 62 inches above the ground. To verify that the theodolite barrel is aligned to the optical line of the glidepath, adjust the vertical reference to a negative glidepath angle, rotate the azimuth 180° and sight on the point established in step (2)(a). If this point is not aligned to the horizontal crosshair, an error in establishing the theodolite position has occurred and the procedure should be accomplished.

b. Waveguide Glide Slope

(1) Due to the complexity of determining the proper location of the theodolite, engineering personnel shall compute this location.

(2) The glidepath signal is considered to emanate from the mid-point of the array; therefore, the theodolite will be oriented to this plane.

(3) Correction Factors. Due to offset distance of the theodolite from the runway centerline and distance from the antenna array, parallax errors will be induced (dissimilar width sensitivities particularly in zone 3). Engineering personnel shall provide the flight inspection crew with correction factors to be applied to the RTT differential trace.

c. Endfire Glide Slope

(1) The glidepath signal is considered to emanate from the phase center of the array and at the elevation plane determined by engineering personnel.

(2) The theodolite shall be positioned using the data in paragraph c(1) corrected for eyepiece height.

d. Localizer. The use of a theodolite, AFIS, or RTT is not required for any inspection on a localizer sited along runway centerline, regardless of category, providing performance can be satisfactorily evaluated by flying a visual centerline track.

The position of the theodolite, when used during localizer evaluations, will be placed on a line perpendicular to the localizer antenna array aligned so as to sight along the reciprocal of the calculated true course and at a point as close to the center of the array as possible.

e. Aircraft Tracking

(1) Glide Slope. The optimum tracking point on the flight inspection aircraft is the glide slope antenna.

(2) Localizer. The optimum tracking point on the flight inspection aircraft is the localizer antenna.

217.3 FLIGHT INSPECTION PROCEDURES

217.31 Checklist

a. ILS Site Evaluations. Site evaluations if performed, are made prior to installation of permanent equipment. The need for a site evaluation, and additional requirements, shall be determined by engineering personnel on the basis of individual site conditions.

b. Periodic Checks. A periodic check without monitors shall consist of an inspection of the localizer and glide slope transmitter that is on the air, plus the operating transmitter of the supporting NAVAIDs. If out-of-tolerance conditions are found, inspect the standby equipment, if available.

c. Periodic with Monitors. Normally consists of a periodic performed on both primary and standby equipment, a monitor check on the operating transmitter, and a check on the operating transmitter of supporting NAVAIDs. Facilities that have dual parallel monitors require a monitor evaluation on one transmitter only. Matching transmitter power and phasing parameters is a maintenance action verifiable without airborne measurements. Facilities gathering reference data may request a special flight inspection to include a monitor check on both transmitters. Facilities that have two individual monitors require monitor evaluations on each transmitter.

d. Frequency Change. Following a localizer (SDF, LDA) or ILS frequency change, conduct a special inspection that fulfills the following requirements: Periodic with monitors (Pm), RF power alarm monitor, and spectrum analysis.

e. Other Component Changes. See paragraph 104.5.

f. Restrictions Based on Commissioning-Only Checks. When a facility restriction is based on a configuration normally checked only on commissioning inspections, e.g., localizer clearances in narrow or coverage with reduced power, document the condition and configuration on the Facility Data Sheet. Conditions found in these configurations do not require revalidation on periodic inspections.

g. Restriction Removal. Restricted facilities shall be evaluated on each inspection with the goal of removing restrictions that are no longer valid. Do not check configurations beyond the requirements for the type of inspection, unless restriction removal is ensured. If the results of the current and last periodic interval inspections indicate a potential for restriction removal, notify the Flight Inspection Technical Support Branch. The Technical Support Branch shall review at least the last five years of inspection history. They must analyze the history and current results for maintenance actions, trends, seasonal differences, etc., to determine if restriction removal is appropriate. If an additional inspection is required, they shall specify and schedule the required checks to be done with the next appropriate inspection. For those restrictions based on commissioning-only configurations, do not remove the restrictions without a check of those configurations.

h. Back Course Use. A localizer back course used for missed approach guidance must meet the same checklist requirements and tolerances as one used for an approach.

i. ILS Critical Area Checks. These checks are usually requested to determine the effects of permitting aircraft, vehicles, or other mobile objects to transition through ILS critical areas. The results of these flight inspections are valid only for the specific conditions existing at the time of the check and are not suitable for determination of facility performance status or reliability.

217.3101 Facility Checklists by Type. Flight inspection requirements are contained in the following checklists and in the discussion paragraphs in this section. The checklists are provided as a guide and do not necessarily indicate a sequence of checks. Consult the text to ensure a complete inspection.

Legend:

Fc = Localizer front course.
Bc = Localizer back course.
C = Commissioning or commissioning type equipment.
E = Site evaluation.
Pm = Periodic inspection with monitors.
P = Periodic inspection without monitors.

a. Single Frequency Localizer, LDA's and SDF's.

NOTE: Bc checks do not apply to uni-directional antennas.

REMARKS:

(1) Maintenance request.

(2) Adjustments to carrier modulation balance will require a subsequent check of course alignment.

(3) Width and clearance should be measured prior to the phasing check. If, after the quadrature phase check, the width has remained the same or has narrowed and/or the clearances have increased from the first width and clearance check, then the phasing has been improved. Final determination of optimum phase should be discussed with facilities maintenance personnel.

(4) Applicable to phase reference SDF's only.

(5) Facilities with dual transmitters and single solid state modulators—check both transmitters.

(6) Replacement of an antenna array with a different type (e.g., V-Ring elements to LDP element, 8-element to 14-element), require commissioning inspection checks, except for those checks not required, as determined jointly by flight inspection and facilities maintenance personnel.

(7) Same type antenna replacements require PM checks, in addition to all of Zone 1 structure (Para 217.3207b) and localizer only structure checks (Para 217.3207a(1)(b)).

Type Check	Ref. Para	Inspection				Facility	Measurements Required					
		E	C (6)	Pm (7)	P	Configuration	MOD	WIDTH	SYM	CLR	ALIGN	STRUC
Spectrum Analysis	217.3201	Reserved										
Ident. & Voice	217.3214	(1)	X	X	X							Fc&Bc
Modulation Level	217.3202	X	X	X	X	Normal	Fc					
Modulation Equality (2)	217.3202 217.3203	(1)	(1)			Carrier Only						
Phasing (3)	217.3205	(1)	(1)			Quadrature	Set to Value of Modulation Equality					
Width & Clearance	217.3206 217.3210	X	X	X	X	Normal	Fc&Bc	Fc&Bc	Fc&Bc	Fc&Bc		
Clearance Comparability	217.3210		X			As Required		Fc&Bc		Fc&Bc		
Alignment and Structure	217.3207	X	X	X	X	Normal	Fc&Bc				Fc&Bc	Fc&Bc
Localizer Only Minima	217.3207	X	X			Normal	Fc&Bc					Fc&Bc
Polarization (One XMTR Only)	217.3213	X	X	X	X	Normal						Fc&Bc
Monitors (5) Width	217.3208	(1)	X	X		Wide		Fc&Bc		Fc&Bc		
		(1)	X			Narrow		Fc		Fc		
Alignment		(1)	X			Shifted Alignment					Fc	
RF Power Monitor Reference (One XMTR Only)	217.3209	(1)	X			Reduced RF Power				Fc&Bc		Fc&Bc
High Angle Clearance (One XMTR Only)	217.32101	X	X			Normal	Fc&Bc			Fc&Bc		
Standby Equipment	217.3401 106.42		X	X								
Standby Power	217.3402 106.43		X			Normal	Fc&Bc	Fc&Bc	Fc&Bc		Fc&Bc	

b. Dual Frequency Localizer.

REMARKS:

(1) Maintenance request.

(2) Adjustments to carrier modulation balance will require a subsequent check of course alignment.

(3) Width and clearance should be measured prior to the phasing check. If, after the quadrature phase check, the width has remained the same or has narrowed and/or the clearances have increased from the first width and clearance check, then the phasing has been improved. Final determination of optimum phase should be discussed with facilities maintenance personnel.

(4) Replacement of an antenna array with a different type (e.g., V-Ring elements to LDP element, 8-element to 14-element), require commissioning inspection checks, except for those checks not required, as determined jointly by flight inspection and facilities maintenance personnel.

(5) Same type antenna replacements require PM checks, in addition to all of Zone 1 structure (Para 217.3207b) and localizer only structure checks (Para 217.3207a(1)(b)).

Type Check	Ref. Para.	Inspection				Transmitter Configuration		Measurements Required					
		E	C (4)	Pm (5)	P	Course XMTR	Clearance XMTR	MOD	WIDTH	SYM	CLR	ALIGN	STRUC
Spectrum Analysis	217.3201	Reserved											
Ident. & Voice	217.3214	(1)	X	X	X								Fc&Bc
Power Ratio	217.3204	(1)	(1)			RF	Normal						
Modulation Level	217.3202	X	X			Normal	Off	Fc					
		X	X			Off	Normal	Fc					
		X	X	X	X	Normal	Normal	Fc					
Modulation Equality (2)	217.3202 217.3203	(1)	(1)			Carrier Only	Off	Fc	Balance Determined by Maintenance				
		(1)	(1)			Off	Carrier Only	Fc	Balance Determined by Maintenance				
Phasing (3)	217.3205	(1)	(1)			Quad	Off		Set to Value of Modulation Equality				
		(1)	(1)			Off	Quad		Set to Value of Modulation Equality				
Width & Clearance	217.3206 217.3210	(1)	(1)			Off	Normal	Fc	Fc				
		X	X	X	X	Normal	Normal	Fc&Bc	Fc&Bc	Fc&Bc	Fc&Bc		
Clearance Comparability	217.3210		X			As Required	As Required		Fc&Bc		Fc&Bc		
Alignment and Structure	217.3207	X	X	X	X	Normal	Normal	Fc&Bc				Fc&Bc	Fc&Bc
Localizer Only Minima	217.3207	X	X			Normal	Normal	Fc&Bc					Fc&Bc
Polarization (One XMTR Only)	217.3213	X	X	X	X	Normal	Normal						Fc&Bc

b. Dual Frequency Localizer.—Continued

Type Check	Ref. Para.	Inspection				Transmitter Configuration		Measurements Required					
		E	C (4)	Pm (5)	P	Course XMTR	Clearance XMTR	MOD	WIDTH	SYM	CLR	ALIGN	STRUC
Monitors Width	217.3208		X			Wide	Normal		Fc				
		(1)	X			Narrow	Wide		Fc&Bc		Fc&Bc		
		(1)	X	X		Wide	Wide		Fc&Bc		Fc&Bc		
Dephase			(1)			ADV Phase	Normal		Fc				
			(1)			RET Phase	Normal		Fc				
			(1)			Normal	ADV Phase		Fc		Fc		
			(1)			Normal	RET Phase		Fc		Fc		
Alignment			X			Shifted Align-ment	Normal					Fc	
RF Power Monitor Reference (One XMTR Only)	217.3209	(1)	X			Reduced RF Power	Reduced RF Power				Fc&Bc		Fc&Bc
High Angle Clearance (One XMTR Only)	217.32101	X	X			Normal	Normal	Fc&Bc			Fc&Bc		
Standby Equipment	217.3401 106.42		X	X									
Standby Power	217.3402 106.43		X			Normal	Normal	Fc&Bc	Fc&Bc	Fc&Bc		Fc&Bc	

c. Null Reference Glide Slope.

CODE: W/A/S = Width, Angle, Symmetry

REMARKS:

(1) Maintenance request.

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Required on commissioning type inspections.

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required						
		E	C	Pm	P		MOD	WIDTH	ANGLE	SYM	STRUC BELOW PATH	CLR	STRUC
Spectrum Analysis	217.3301	Reserved											
Engineering Support Tests	217.3305	(1)	(1)			As Required							
Modulation Level	217.3302	X	X	X	X	Normal	X						
Modulation Equality	217.3303	(1)	(1)			Carrier Only	X						
Phasing	217.3304	(1)	(1)			Quadrature	SET TO VALUE FOUND IN MODULATION EQUALITY						
Spurious Radiation	217.33053	(1)	(1)			Dummy Load Radiating Signal							X
W/A/S	217.3306 217.3313	X	X	X	X	Normal		X	X	X	X, (2)		
Structure	217.3310 217.3313	X	X	X	X	Normal	X		X				X
Clearance	217.3307	X	X			Normal						X	
Tilt (One XMTR Only)	217.3309 217.241	X	X			Normal	X		X			X	
Mean Width (One XMTR Only)	217.3308	(1)	X			Normal		X		X			
Monitors Width	217.3313	(1)	X	X		ADV Phase		X	X		X, (2)	(3)	
		(1)	X	X		RET Phase		X	X		X, (2)	(3)	
		(1)	X	X		Wide		X	X		X, (2)	(3)	
			X			Narrow		X	X		X, (2)		
RF Power Monitor Reference (One XMTR Only)	217.3314 217.241	(1)	X			Reduced RF Power							
Standby Equipment	217.3401 106.42		X	X									
Standby Power	217.3402 106.43		X			Normal	X	X	X	X	X, (2)		

d. Sideband Reference Glide Slope.

CODE: W/A/S = Width, Angle, Symmetry

REMARKS:

(1) Maintenance request.

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Required on commissioning type inspections.

(4) Check on one transmitter only if the equipment has a common power divider and parallel monitors.

(5) Perform actual angle check at the completion of any width or angle monitor reference inspection.

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required						
		E	C	Pm (5)	P		MOD	WIDTH	ANGLE	SYM	STRUC BELOW PATH	CLR	STRUC
Spectrum Analysis	217.3301	Reserved											
Engineering Support Tests	217.3305	(1)	(1)			As Required							
Modulation Level	217.3302	X	X	X	X	Normal	X						
Modulation Equality	217.3303	(1)	(1)			Carrier Only	X						
Phasing	217.3304	(1)	(1)			As Required	SET TO VALUE FOUND IN MODULATION EQUALITY						
Spurious Radiation	217.33053	(1)	(1)			Dummy Load Radiating Signal							X
W/A/S	217.3306 217.3313	X	X	X	X	Normal		X	X	X	X, (2)		
Structure	217.3310 217.3313	X	X	X	X	Normal	X		X				X
Clearance	217.3307	X	X			Normal						X	
Tilt (One XMTROnly)	217.3309 217.241	X	X			Normal	X		X			X	
Mean Width (One XMTR Only)	217.3308	(1)	X			Normal		X		X			

d. Sideband Reference Glide Slope. Continued

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required						
		E	C	Pm (5)	P		MOD	WIDTH	ANGLE	SYM	STRUC BELO W PATH	CL R	STRUC
Monitors (5) Angle	217.3313		X	(1)		High Angle (4)		X	X, (4)		X, (2)		
		(1)	X	X		Low Angle (4)		X	X, (4)		X, (2)	(3)	
Width						Upper Antenna:							
			X	X		ADV Phase		X	X		X, (2)	(3)	
			X	X		RET Phase		X	X		X, (2)	(3)	
						Main Sideband:							
			X			ADV Phase		X	X		X, (2)		
			X			RET Phase		X	X		X, (2)		
		(1)	X	X		Wide		X	X		X, (2)	(3)	
			X			Narrow		X	X		X, (2)		
RF Power Monitor Reference (One XMTR Only)	217.3314 217.241	(1)	X			Reduced RF Power							
Standby Equipment	217.3401 106.42		X	X									
Standby Power	217.3402 106.43		X			Normal	X	X	X	X	X, (2)		

e. Capture Effect Glide Slope.

CODE: W/A/S = Width, Angle, Symmetry

REMARKS:

(1) Maintenance request.

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Required on commissioning type inspections.

(4) Perform this check on both transmitters at the request of maintenance.

(5) Commissioning on the transmitter used to check phase verification is not required if the phaser monitor/limit setting is 15 degrees or less.

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required						
		E	C	Pm	P		MOD	WIDTH	ANGLE	SYM	STRUC BELOW PATH	CLR	STRUC
Spectrum Analysis	217.3301	Reserved											
Engineering Support Tests	217.3305	(1)	(1)			As Required							
Modulation Level	217.3302	X	X	X	X	Normal:	X						
Modulation Equality	217.3303	(1)	(1)			Carrier Only	X						
Phasing Proc. 1 or 2	217.3304	(1)	(1)			As Required	SET TO VALUE FOUND IN MODULATION EQUALITY						
Phase Verification (4)	217.3304	(1)	X			As Required	X	X	X	X		X	
Spurious Radiation	217.33053	(1)	(1)			Dummy Load Radiating Signal							X
W/A/S	217.3306 217.3313	X	X	X	X	Normal		X	X	X	X, (2)		
Structure	217.3310 217.3313	X	X	X	X	Normal	X		X				X
Clearance	217.3307	X	X			Normal						X	
Tilt (One XMTR Only)	217.3309 217.241	X	X			Normal	X		X			X	
Mean Width (One XMTR Only)	217.3308	(1)	X			Normal		X		X			

e. Capture Effect Glide Slope—Continued.

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required						
		E	C	Pm	P		MOD	WIDTH	ANGLE	SYM	STRUC BELO W PATH	CL R	STRUC
Monitors Width	217.3313	(1)	X	X		Middle Antenna ADV Phase		X	X		X, (2)	(3) (5)	
		(1)	X	X		RET Phase		X	X		X, (2)	(3) (5)	
		(1)	X			Narrow		X	X		X, (2)		
		(1)	X	X		Primary XMTR wide and clearance XMTR reduced modulation		X	X		X, (2)	(3)	
		(1)	X			Middle Antenna Attenuate		X	X		X, (2)	(3)	
		(1)	X	X		Upper Antenna Attenuate		X	X		X, (2)	(3)	
RF Power Monitor Reference (One XMTR Only)	217.3314 217.241	(1)	X			Reduced RF Power							
Standby Equipment	217.3401 106.42		X	X									
Standby Power	217.3402 106.43		X			Normal	X	X	X	X	X, (2)		

f. Waveguide Glide Slope with Auxiliary Waveguide Antennas.

NOTE: For those waveguide glide slopes that do not have auxiliary waveguide antennas, complete all checklist items except the following monitor checks: Upper Auxiliary Waveguide—attenuate, advance and retard—dephase; Lower Auxiliary Waveguide—attenuate; Upper and Lower Waveguide—simultaneously advance and retard dephase.

CODE: W/A/S = Width, Angle, Symmetry

REMARKS:

(1) Maintenance request.

(2) If structure below path tolerances cannot be met, clearance procedures and tolerances will be applied.

(3) Required on commissioning type inspections.

(4) This check can be made on either the upper or lower main antenna feed but both steps must be performed on the same feed.

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required						
		E	C	Pm	P		MOD	WIDTH	ANGLE	SYM	STRUC BELOW PATH	CLR	STRUC
Spectrum Analysis	217.3301	Reserved											
Engineering Support Tests	217.3305	(1)	(1)			As Required							
Modulation Level	217.3302	X	X	X	X	Normal	X						
Modulation Equality	217.3303	(1)	(1)			Carrier Only							
Spurious Radiation	217.33053	(1)	(1)			Dummy Load Radiating Signal							X
W/A/S	217.3306	X	X	X	X	Normal		X	X	X	X, (2)		
Structure	217.3310	X	X	X	X	Normal	X		X				X
Clearance	217.3307	X	X			Normal						X	
Tilt (One XMTR Only)	217.3309 217.241	X	X			Normal	X		X			X	
Mean Width (One XMTR Only)	217.3308	(1)	X			Normal		X		X			

f. Waveguide Glide Slope with Auxiliary Waveguide Antennas.—Continued

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required						
		E	C	Pm	P		MOD	WIDTH	ANGLE	SYM	STRUC BELOW PATH	CL R	STRUC
Monitors Width	217.3313	(1)	X	X		Wide		X	X		X, (2)	(3)	
			X			Narrow		X	X		X, (2)		
						Main Sideband:							
			X	X		ADV Phase		X	X		X, (2)	(3)	
			X	X		RET Phase		X	X		X, (2)	(3)	
One XMTR Only						Upper Auxiliary Waveguide:							
			X			Attenuate		X	X, (4)			X	X
			X			ADV Phase		X	X, (4)			X	X
			X			RET Phase		X	X, (4)			X	X
One XMTR Only			X			Lower Auxiliary Waveguide: Attenuate		X	X, (4)			X	X
One XMTR Only						Upper & Lower Waveguide Simultaneously:							
			X			ADV Phase		X	X		X, (2)		X
			X			RET Phase		X	X		X, (2)		X
One XMTR Only						Main Waveguide Feed Phaser:							
			X	X		ADV Phase (4)		X	X		X, (2)	(3)	
			X	X		RET Phase (4)		X	X		X, (2)	(3)	
Angle One XMTR Only			X			Lower Main Waveguide Feed: Attenuate (High Angle)		X	X		X, (2)		
One XMTR Only			X			Upper Main Waveguide Feed: Attenuate (Low Angle)		X	X		X, (2)	(3)	
RF Power Monitor Reference (One XMTR Only)	217.3314 217.241	(1)	X			Reduced RF Power							
Standby Equipment	217.3401 106.42		X	X									
Standby Power	217.3402 106.43		X			Normal	X	X	X	X	X, (2)		

g. Endfire Glide Slope Standard (capture effect in the horizontal plane.)

CODE: W/A/S = Width, Angle, Symmetry

REMARKS:

(1) Maintenance request.

(2) If structure below path tolerances cannot be met, clearance procedures and techniques will be applied.

(3) Required on commissioning type inspections.

(4) On facilities without a quadrature phase monitor, conduct dephase check on the width monitor with main sideband dephasing of ? 15? or less. If a quadrature phase monitor is installed, a commissioning check is required, but no periodic dephase check is needed.

(5) Clearance above and below path required. (See Paragraph 217.241.)

(6) Perform actual angle check at the completion of any width or angle monitor inspection.

(7) Perform also after antenna repair, replacement, modification, or any adjustment maintenance expects will change transverse structure and/or clearances.

Type Check	Ref. Para.	Inspection				Facility Configuration		Measurements Required						
		E	C (4)	Pm (6)	P	Primary XMTR	Clear XMTR	MOD	WIDTH	ANGLE	SYM	STRUC BELOW PATH	CLR	STRUC
Spectrum Analysis	217.3301	Reserved				Reserved								
Engineering Support Tests	217.3305	(1)	(1)			As Required								
Modulation Level	217.3302	X	X	X	X	Norm	Norm	X						
Modulation Equality	217.3303	(1)	(1)			Carrier Only	OFF	X						
W/A/S	217.3306	X	X	X	X	Norm	Norm		X	X	X	X, (2)		
Structure	217.3310	X	X	X	X	Norm	Norm	X		X				X
Clearance	217.3307	X	X			Norm	Norm						X	
Transverse Structure	217.3311	X	X	(1)	(1)	Norm	OFF							X
Transverse Structure (7)	217.3311	X	X	X		Norm	Norm							X
Tilt (One XMTR Only)	217.3309 217.241	X	X			Norm	Norm	X		X			X	
Mean Width (One XMTR Only)	217.3308	(1)	X			Norm	Norm		X		X			
Transverse Structure (7)	217.3311	(1)	X	(1)	(1)	Norm	Reduced RF Power							X
Clearance at 5? of LCZR course on G/S equip side (5) (7)	217.3307 217.241	(1)	X			Norm	Reduced RF Power						X	
Clearance at 8? of LCZR course on side opposite G/S equip (5) (7)	217.3307 217.241	(1)	X			Norm	Reduced RF Power						X	
Spurious Radiation	217.33053	(1)	(1)			Dummy Load	Dummy Load							X

g. Endfire Glide Slope? Standard (capture effect in the horizontal plane)? Continued.

Type Check	Ref. Para.	Inspection				Facility Configuration		Measurements Required						
		E	C (4)	Pm (6)	P	Primary XMTR	Clear XMTR	MOD	WIDTH	ANGLE	SYM	STRUC BELOW PATH	CLR	STRUC
Monitors Width	217.3313	(1)	X	X		Wide	Norm		X	X		X, (2)	(3)	
Phase		(1)	X	(4)		ADV Phase	Norm		X	X		X, (2)	(3)	
		(1)	X	(4)		RTD Phase	Norm		X	X		X, (2)	(3)	
		(1)	X			Narrow	Norm		X	X		X, (2)		
Angle		(1)	X	(1)		Main Array: Dephase for High Angle	Norm		X	X		X, (2)		
		(1)	X	X		Main Array: Dephase for Low Angle	Norm		X	X		X, (2)	(3)	
RF Power Monitor Reference (One XMTR Only)	217.3314 217.241	(1)	X			Reduced RF Power	Reduced RF Power							
Transverse Structure	217.3311		(1)			Norm	ADV CLR ANT Phase							X
			(1)			Norm	RET CLR ANT Phase							X
Standby Equipment	217.3401 106.42		X	X										
Standby Power	217.3402 106.43		X					X	X	X	X	X, (2)		

217.3102 General Checklist. During a specific inspection, check the following items:

	A	E	C	PM	P
75 Mhz Marker Beacons	X	-	X	X	X
Compass Locator	X	-	X	X	X
DME	X	-	X	X	X
Lighting Systems	X	-	X	X	X
Standard Instrument Approach Procedure (see Sections 105 and 214)	X	(1)	X	(1)	(1)

(1) As required by ground technical or flight inspection personnel.

217.32 Detailed Procedures - Localizers. Unless otherwise noted, the following procedures apply to all localizers, offset localizers, LDAs, and SDFs.

217.3201 Spectrum Analysis. Reserved.

217.3202 Modulation Level. This check measures the modulation of the radiated signal.

a. Approved Procedure--Front Course. Measure modulation while inbound on the localizer, between 10 miles and 3 miles from the localizer antenna, and on glidepath (at LCA for localizer-only facilities). Preliminary checks may be made when transitioning the "on-course" position during course width and symmetry measurements; however, they must be validated while flying inbound on-course. Some dual frequency antennas do not provide enough clearance power to measure modulation on centerline. For these facilities, measure the clearance-only modulation level while inbound between 5 and 10? off-course at LCA with the clearance transmitter in the modulation balance configuration.

b. Approved Procedure--Back Course. Measure modulation by using the flight procedures described in a. above. On single frequency localizers, adjustments to front course modulation will also affect the back course; therefore, adjustments are not required on the back course. Where a separate antenna provides clearance, as well as a back course (such as the waveguide system), modulation checks and adjustments of the clearance transmitter(s) are valid only while on the back course, unless the course transmitter is OFF.

217.32021 Modulation shall also be measured during the NORMAL configuration clearance checks required by paragraphs 217.3210 and 217.32101. Some receivers see excessive modulation as low clearances. Out-of-tolerance modulation shall be a basis for restrictions on facilities installed or reconfigured with new type antennas after January 1, 2000. To implement this requirement, perform a 35-35? clearance arc in NORMAL on the front and back course at the first available opportunity. Document the results in the report and Facility Data Sheet. Subsequently, the check needs only to be performed when a 35-35? arc in NORMAL is required per the applicable checklist.

217.3203 Modulation Equality. This check is performed to obtain a crosspointer value which will be used as a reference for phasing.

Approved Procedure. Position the aircraft as outlined in paragraph 217.3202, Modulation Level. Adjustments to modulation equality will require a subsequent check of course alignment.

217.3204 Power Ratio Check. The purpose of this check is to measure the ratio of power between the course and clearance transmitters of dual frequency localizers.

(1) When using the spectrum analyzer, position the aircraft on the localizer on-course within 10 miles and in line-of-sight of the antenna or parked on the runway on-course in line-of-sight of the antenna. Compare the relative signal strength of the course and clearance transmitters with the course transmitter in RF power alarm and the clearance transmitter in normal.

(2) If a spectrum analyzer is not available, position the aircraft on the runway centerline/on-course at or near the approach end of the runway in line-of-site of the antenna. Use the AGC meter or equivalent and note the voltage level of the facility in the following configurations:

(a) Course transmitter in RF alarm; clearance transmitter OFF.

(b) Clearance transmitter in normal; course transmitter OFF.

Compute the power ratio using the dual frequency power ratio formula (see Section 302).

217.3205 Phasing. The purpose of this check is to determine that the phase relationship between the sideband and carrier energy is optimum. The facility will normally be phased using ground procedures. No specific requirement exists for airborne phasing.

a. Approved Procedure--Front Course. Since antennas vary greatly, obtain the correct azimuth for phasing the facility from facility maintenance personnel. Fly inbound toward the antenna on the appropriate azimuth at LCA between 10 and 3 miles. Transmit the crosspointer values to assist the ground technician to adjust the phasing. The optimum quadrature phase condition is established when the microampere deflection is the same as that found when checking modulation equality.

b. Approved Procedure--Back Course. If maintenance requests phasing on the back course, apply the procedures described in a. above.

217.3206 Course Sector Width and Symmetry. The purpose of this check is to establish and maintain a course sector width and ratio between half-course sectors that will provide the desired displacement sensitivity required at the procedural missed approach point (MAP) or threshold and be within the limitations of the procedural protected area.

a. Width Requirements. Localizers, offset localizers, and LDA's shall be tailored to a course sector width not greater than 6? and a linear sector width of 700 ft at the following points:

(1) Point C for LDA and SDF

(2) Point B for runways less than 4000 ft long and for runways which do not conform to precision instrument design standards.

(3) Point T for facilities supporting all other applications.

The tailoring requirement may be waived for facilities supporting other than CAT II or III operations if tailoring cannot be achieved due to siting constraints, performance derogation etc.; however, the final width shall be established as close as possible to the optimum. The justification shall be included in the flight inspection report. The decision to have other than a tailored course width is not a flight inspection function and should be made at the applicable Region or comparable military level. If the course sector width on a facility which supports a precision approach will not provide for at least 400 ft linear width at the runway threshold, the course shall be restricted as unusable inside the point where the linear width is 400 ft. The commissioned course width of an SDF shall be no greater than 12.0?. If the course width is adjustable, it shall be tailored. USAF CAT I localizers with antenna to threshold distance which would cause the tailored width to be less than 3? will be commissioned at 3?. Facilities previously commissioned at less than 3? need not be widened only to meet the 3? requirement.

b. Approved Procedure. This procedure applies to the front course (and back course if it is used for an approach or missed approach). Measure the course sector width and symmetry between 4 and 14 miles from the localizer antenna at the LCA, providing the modulation levels are in tolerance.

Higher altitudes may be used, provided that a comparability check in the normal configuration was made (usually at commissioning) at the LCA and the higher altitude, and the results were within tolerance and were within ±0.2? (if the higher altitude is used, it shall be documented on the data sheet). Subsequent inspections may be made at LCA, the higher altitude, or any altitude in between. If a comparability check has not been completed satisfactorily, altitudes above the LCA shall not be used to evaluate course width. Re-establish width monitor references at the LCA, and plot clearances IAW Paragraphs 217.3210 and Order 8240.36, Appendix 10, if the commissioned width is changed. If clearance comparability was satisfactory prior to the course width change, re-check the Procedure 1 / 2 configurations at the LCA.

Further checks at the desired higher altitude are not required if these minimum clearance levels are met.

(1) Basic Method. A crossing, perpendicular to the on-course, shall be made in each direction, maintaining a constant airspeed (to average out any wind component) over a checkpoint of a known distance from the localizer antenna, i.e., outer marker, FAF, etc. If ground speed or along-track outputs are available, only one crossing is required. Measure the course sector width and calculate the symmetry (use the appropriate formulas in Section 302).

(2) Theodolite or Tracking Device Method. Position the theodolite or tracking device in accordance with paragraph 217.25, Theodolite Procedures. Only one crossing is required; maintain a constant airspeed. Reference the course sector width to the azimuth reference marks of the theodolite (usually spaced 5? apart). Measure the course sector width, using a device such as 10 point dividers, and calculate the symmetry.

NOTE: An RTT may be used to track an aircraft throughout the course sector. Apply the course sector width received to the calibration of the RTT.

217.3207 Course Alignment and Structure. These checks measure the quality and alignment of the on-course signal. The alignment and structure checks are usually performed simultaneously; therefore, use the same procedures to check alignment and structure.

a. Approved Procedure. This procedure applies to the front course (and the back course) if it is used for an approach or missed approach).

(1) General. Evaluate the course along the designed procedural azimuth from the furthest point required by the type of inspection being conducted throughout the remaining zones. Maintain the published or proposed procedural altitudes through each approach segment until intercepting the glidepath and then descend on the glidepath to Point C or runway threshold.

(a) For a localizer-only approach, the published or proposed procedural altitudes shall be maintained in each segment, except the final segment shall be flown as follows: Upon reaching the FAF inbound, descend at a rate of approximately 400 ft per mile (930 ft per minute at 140 knots; 800 ft per minute at 120 knots) to an altitude of 100 ft below the lowest published MDA and maintain this altitude to Point C, which is the MAP. NOTE: See Section 301 definition of Point C for localizer only approaches.

(b) For ILS approaches which support localizer-only minima, the procedure specified in (a) above shall be used in addition to the run on normal glidepath during the following inspections: Site, Commissioning, and Specials for antenna system change, user complaint or site modifications, and on a periodic inspection any time there is a significant deterioration of localizer structure.

(c) For localizers which are aligned along the runway centerline, the aircraft may be positioned along the runway centerline by visual cues, or theodolite. When RTT or AFIS equipment is used, the localizer on-course signal shall be flown. For localizers which are not aligned along the runway centerline, theodolite, RTT, or AFIS are the preferred methods of evaluation. For localizers oriented toward a non-descript point in space, where adequate visual checkpoints are not available to validate actual course alignment, the alignment may be determined to be either Satisfactory (S), or Unsatisfactory (U) in lieu of course alignment values (refer to paragraph 214.32011). The initial monitor evaluation shall establish an equality of modulation reference for subsequent alignment and monitor comparison.

(2) Roll-Out Procedures.

(a) Site, Commissioning, Reconfiguration and Categorization Inspections of centerline oriented facilities. Use the procedures in paragraph a(1) until reaching Point C. Cross Point C at 100 ft, runway threshold at approximately 50 ft, and continue on the extended glidepath angle to the touchdown point. Continue the landing roll and determine the actual course alignment for ILS Zones 4 and 5. Measure the course structure from the actual alignment. If the actual alignment for Zones 4 and 5 cannot be determined using this method, taxi the aircraft along the runway centerline from abeam the glide slope to Point E. Record the raw crosspointer information and mark, abeam the glide slope, Point D and Point E. Manually calculate the actual course alignment and structure for each of the required zones. This is a comparison check intended to authorize the 50 ft run as a periodic check of Zone 4 and 5 structure. If the results of the 50 ft run do not accurately reflect that achieved during roll-out checks, document that structure analysis of Zones 4 and 5 must be roll-out checked on future inspections.

(b) Periodic or Special Inspections which require Structure Analysis. Use the procedures in paragraph a(1) until reaching Point C. Cross Point C at 100 ft, runway threshold at 50 ft, and then conduct a low approach at 50 to 100 ft, on runway centerline, throughout the required zones. If the aircraft cannot be maintained on centerline for evaluation of Zones 4 and 5 due to wind conditions, the evaluation may be conducted by taxiing the aircraft down centerline throughout Zones 4 and 5.

NOTE: If structure appears to have deteriorated since the previous inspection, or if out-of-tolerance structure is found, verify the results of this check by flying the procedure listed in a(2)(a) above.

b. Zones to be inspected for structure. All ILS localizers sited on the extended runway centerline shall be inspected and analyzed through Zones 1, 2, 3, 4, and 5 (runways less than 5,000 ft long do not have Zone 5) on all inspections requiring alignment or structure validation. These localizers shall be classified according to the furthest point at which the structure conforms to Category III tolerance. Specific reporting instructions are contained in Order 8240.36. This classification is for autoland authorization. Other facilities shall be inspected and analyzed in Zones 1, 2, and 3. See Section 301 and Figure 217-1 for zone identification.

Type Approach/ Facility	**Zones Required for Unrestricted Service (1)**
Category III	Zones 1, 2, 3, 4, 5
Category II ILS	Zones 1, 2, 3, and 4 (see Paragraph 107.34) **(2)**
Category I ILS	Zones 1, 2, 3
Other types of facilities or approaches	Zones 1, 2, 3

NOTE 1: During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change inspection? check all of Zone 1. All other inspections (i.e., periodic, periodic with monitors, etc.) evaluate structure from GSI or the FAF (whichever is further) through all other required zones. For After Accident Inspections, see paragraph 104.51.

Note 2: Category II localizers failing to meet structure tolerance in Zone 4 will not be shown as restricted on the flight inspection report; however, a NOTAM will be issued. See paragraph 107.34.

c. Alignment Areas. Determine the course alignment in the following areas:

Front Course	From	To
CAT I, II, III	One mile from runway threshold	Runway threshold
ILS Zone 4	Runway threshold	Point D
ILS Zone 5	Point D	Point E
Offset Localizers	One mile from runway threshold	Runway threshold or abeam runway threshold
LDAs and SDFs	One mile from Point C	Point C
Back Course		
All Types of Facilities	Two miles from the antenna	One mile from the antenna

NOTE: When a restriction occurs in an area where alignment is normally analyzed, measure alignment through manual or AFIS analyzation of the average course signal in the following areas:

From	To
One mile from the start of the restriction.	The start of the restriction.

217.32071 Glide Slope Signal on Localizer Back Course. Evaluation of localizer back course approaches shall also include an evaluation for active glide slope signals. Glide slope signals that result in flag or CDI activity shall be cause for immediate action to alert pilots to disregard all glidepath indications on the back course approach (i.e., NOTAM). Ensure the alert will be printed on the localizer back course instrument approach chart.

217.3208 Monitor References. The inspector shall ensure that the facility is set at the monitor reference prior to each check. Monitor references shall be checked IAW paragraph 217.31c when prescribed by the checklist and when applicable on special inspections. At the conclusion of any width monitor inspection, return the facility to normal, and check and report the resulting course sector width and symmetry (paragraph 217.3206).

a. Alignment Reference. This check is performed to assure that the monitors will detect a specific shift of the localizer course.

(1) Approved Procedure? Front Course. It is not necessary to verify ground alignment monitor checks in the air or to verify airborne alignment monitor checks on the ground.

Request the course be misaligned to the monitor alarm limits each side (90 Hz/150 Hz) of the operational course. Both the recorder and the visual display shall be used to verify course alignment shifts. During any inspection, the monitor limits shall be referenced to the designed on-course alignment according to facility category.

(a) Ground. After the airborne localizer alignment has been determined, position the aircraft near the runway threshold where the stable crosspointer is received. The aircraft may be displaced as much as 75?A from the on-course signal. (This option is authorized, providing the sensitivity of the course sector width is linear.) The received course indication shall be referenced to the alignment found airborne. Request that maintenance shift the course to both of the monitor limit points and then return to normal.

At facilities that are installed offset to the runway, the alignment monitor limits may be established with the aircraft on the ground within 75?A of the on-course signal; but the aircraft shall not be positioned closer than 3,000 ft from the antenna array. If these two conditions cannot be met, perform this check in the air (see (b) below).

If monitors are initially checked on the ground and alignment is then adjusted based on airborne analysis, a monitor re-check is not required, providing the following criteria are met:

<u>1</u> In-tolerance flag/modulation and AGC exist.

<u>2</u> Crosspointer is stable.

<u>3</u> Crosspointer data are recorded as found during adjustment and at the final setting.

<u>4</u> The monitor shift on the ground, when applied to the new airborne alignment, is in tolerance.

<u>5</u> Monitor settings are not changed after the alignment is adjusted.

(b) Airborne. Perform airborne alignment monitor checks while inbound on the designed procedural azimuth (on localizers aligned along runway centerline, the aircraft should be aligned with the centerline extended). Measure the alignment shifts to monitor limits by recording the instantaneous course displacements or course shifts as referenced to runway centerline extended. If feasible, this may be accomplished on one run during which both limit points and a return to normal are recorded.

(c) Equality of Modulation. When course alignment is satisfactory and a monitor inspection is required, localizers may be evaluated for monitor references using equality of modulation method. This method may be used on all categories of localizers with the concurrence of maintenance personnel. All facilities shall be flown to establish the alignment in a normal operating configuration. Once the alignment has been established, maintenance will set up an equality of modulation configuration. The equality used to establish the alignment will become the reference for the subsequent monitor readings. When requested, maintenance personnel will unbalance the modulation to achieve the monitor reference point. Measure the displacement in microamps, repeat the procedure in the other direction, then restore to normal. This may be accomplished in the air or on the ground and need not be performed on centerline. Use of this method will be noted in the remarks section of the flight inspection report.

(2) Approved Procedure? Back Course. This check may be accomplished on the back course using the procedures described in paragraph (b) above, or on the front course, as in paragraph (a) or (b) without the waveguide transmitter radiating.

b. Width Reference - Approved Procedure. Use the flight procedure and methods described in paragraph 217.3206.

217.3209 RF Power Monitor Reference. This inspection is conducted to determine that the localizer meets specified tolerances throughout the service volume while operating at reduced power.

a. Approved Procedure. This procedure applies to the front course (and the back course if it is used for an approach or missed approach).

This check shall be conducted with the facility operating at reduced power. Check for interference, signal strength, clearances, flag alarm, identification, and structure as follows:

Steps:

(1) Fly an arc across the localizer course at 18 miles* from the antenna at 4,500 ft above site elevation throughout Sector 1.

(2) Repeat step one, except fly across the localizer at the LCA.

(3) Proceed on course, inbound from 18 miles*, maintaining the LCA to 10 miles** from the antenna.

(4) Fly an arc across the localizer course at 10 miles** from the antenna at the LCA throughout Sectors 1 and 2 (and 3, if procedurally required).

(5) Maintain the LCA and proceed inbound on course until reaching 7? above the horizontal (measured from the localizer antenna) or point C, whichever occurs last.

(6) If an ESV is requested, fly the following <u>in addition to Runs (1) through (5)</u>: If an ESV altitude is requested within the SSV distance, special consideration will be applied to localizer support.

(a) Fly an arc across the localizer at the ESV distance and the highest requested ESV altitude, throughout Sector 1.

(b) Repeat Step (6)(a), except fly at the lowest requested ESV altitude.

NOTE: If one procedural altitude is requested, only one ESV arc is required.

(c) Proceed inbound at the lowest ESV altitude to 18 miles*.

* 25 miles from the antenna for ICAO Service Volumes.

** 17 miles from the antenna for ICAO Service Volumes.

217.3210 Clearance. Clearances are measured to ensure that the facility provides adequate off-course indications throughout the service volume (or ESV, whichever is greater).

a. Approved Procedure. This check applies to the front course (and the back course if it is used for an approach or missed approach).

The clearance orbit will be conducted at a radius between 6 to 10 miles from the antenna at the LCA. On periodic checks, clearances may be checked up to a distance of 14 nm from the localizer antenna. Verify any unusual/out-of-tolerance indications inside 10 nm. If the condition repeats, or if unable to verify due to weather or ATC restrictions, take appropriate NOTAM/restriction action.

b. Clearance Comparability. In some cases it may be necessary to perform clearance measurements at altitudes higher than LCA (e.g., weather, restricted airspace, or ATC limitation). After commissioning, higher altitudes may be used, provided a comparability check is made (usually at commissioning) at the LCA and higher altitude to document clearances. If a comparability check has not been completed satisfactory, altitudes above the LCA shall not be used to evaluate clearances.

On commissioning type checks, to include new type antenna installations/replacements, this comparison shall be accomplished. Document the data sheet as to the procedure used (see below) and altitude flown. The clearances will be plotted IAW Order 8240.36.

NOTE: The lower altitude is recommended and should be attempted on all inspections. Clearance checks above LCA should be the exception.

c. Procedures 1 and 2 involve airborne analysis differences only. Procedure 1 will be used for all facilities, unless the lowest clearance condition configuation at the desired higher altitude produces clearances higher than the same configuration at LCA. Procedure 2 authorizes slightly higher clearances at the desired higher altitude than at LCA, but can only be used if the more stringent clearance tolerances are applied at the LCA. Comparability is required in unrestricted areas of coverage and on one transmitter only. If comparability is unsatisfactory, clearly document the reason.

(1) Procedure 1. Perform the following clearance runs to ? 35?.

(a) Evaluate and plot clearances in Normal Configuration at LCA. If the lowest Sector 2 clearances are less than 165 ?A, the check is UNSAT.

(b) Evaluate and plot clearances in Lowest Clearance Configuation (wide or narrow alarm reference) at LCA. If the lowest Sector 2 clearances are less than 150 ?A, the check is UNSAT.

NOTE: If Step b is UNSAT, further comparability checks are not required.

(c) Lowest Clearance Configuration at Desired Higher Altitude. Repeat at the desired higher altitude the Run (1)(a) or (1)(b) configuration that produced the lowest Sector 2 clearances at LCA. If the lowest clearances at the higher altitude are greater than those found at LCA, the check is UNSAT. Plot clearances <u>only</u> if the comparability is SAT.

(2) Procedure 2. Perform the following clearance runs to ? 35?.

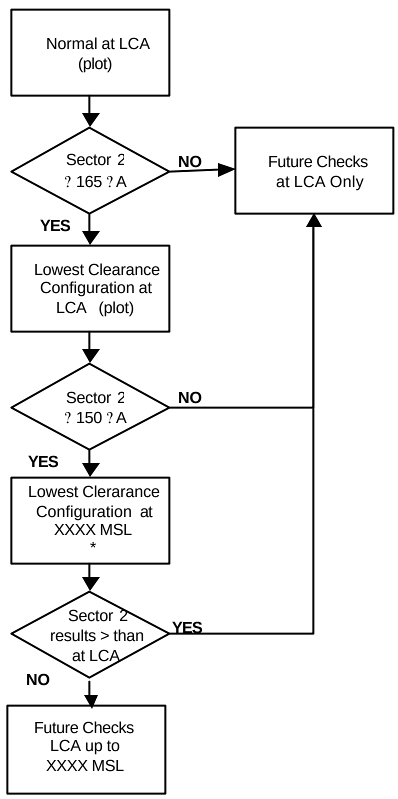
(a) Evaluate and plot clearances in Normal Configuration at LCA. If the lowest Sector 2 clearances are less than 180?A, the check is UNSAT.

(b) Evaluate and plot clearances in Lowest Clearance Configuration (wide or narrow alarm reference) at LCA. If the lowest Sector 2 clearances are less than 160?A, the check is UNSAT.

NOTE: If Step b is UNSAT, further comparability checks are not required.

Procedure 1

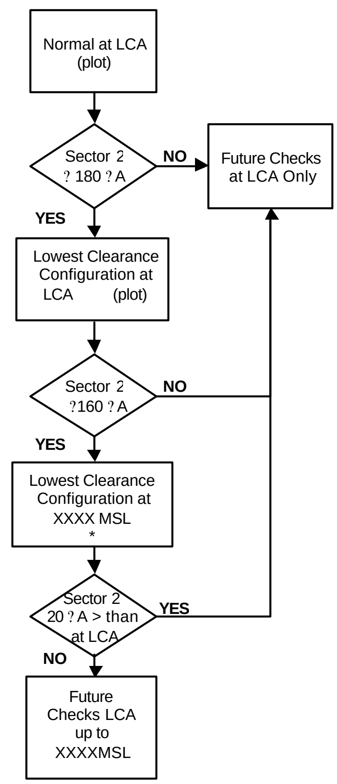
NOTE:
All arcs 35? to 35?



* Plot if Clearance Comparability SAT

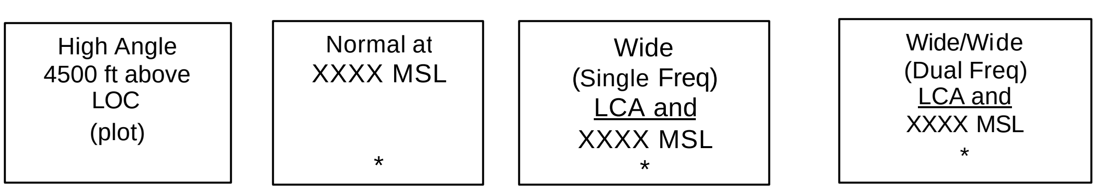
Procedure 2

NOTE:
All arcs 35? to 35?



* Plot if Clearance Comparability SAT

COMMISSIONING TYPE CLEARANCE CHECKS



(c) Lowest Clearance Configuration at Desired Higher Altitude. Repeat at the desired higher altitude, Run (2)(a) or (2)(b) configuration that produced the lowest Sector 2 clearances at LCA. If the lowest clearances at the higher altitude are more than 20?A greater than those found at LCA, the check is UNSAT. Plot clearances only if the comparability is SAT.

d. Lowest Clearance Configuration. The normal or alarm reference condition that causes the lowest clearances will not always be a periodic monitor check condition. Document the flight inspection report and the data sheet with the configuration that produces the lowest clearance values. Inspections to remove a restriction based on clearances shall include a check of all clearance commissioning configurations. See Paragraph 217.31g.

e. Commissioning Plots. On commissioning type inspections, the following additional clearance checks shall be evaluated and plotted on one transmitter for historical reference, only if Procedures 1 or 2 clearance comparability checks are SAT:

(1) Course and Clearance Transmitters Wide (dual frequency)/Course Transmitter Wide (single frequency) at LCA.

(2) Course and Clearance Transmitters Wide (dual frequency)/Course Transmitter Wide (single frequency) at Desired Higher Altitude.

(3) Normal Configuration at the Desired Higher Altitude (if this altitude is different from the Paragraph 217.32101, High Angle Clearance Check).

f. Inspections.

(1) Commissioning. Check clearances in both the normal and the monitor limit *configurations* described in the appropriate checklist.

(2) Monitor Reference Evaluations. Check clearances in the monitor limit configurations described in the appropriate checklist. It is not necessary to check clearances in the normal configuration if the clearances found during the monitor checks are equal to or greater than the tolerances required for normal.

(3) Facilities documented with Procedure 2 comparability must be re-checked at LCA if clearances are found at less than 160?A in any configuration on any periodic check. If the re-check at LCA is satisfactory, the comparability check shall be reaccomplished, or altitudes other than the LCA will not be used to check clearances.

(4) Verify clearances at LCA at least every 1,080 days for all facilities authorized clearance evaluations at higher altitudes. This check determines if environmental changes affect clearances at the LCA while not affecting clearances at the higher altitudes. Fly one clearance run (normal or alarm) at LCA. Values less than 200 ?A may indicate a potential clearance problem; however, if the minimum clearances required to authorize checks at higher altitudes are maintained at the LCA (IAW Paragraph 217.3210c), higher altitudes may continue to be used.

217.32101 High Angle Clearance. This check determines that the transmitted signals provide proper off-course indications at the upper limit of the service volume. Conduct this check and plot clearances during a site evaluation, commissioning inspection, or when a change in location, height, or type of antenna is made.

Approved Procedure. This check applies to the front course (and the back course if it is used for an approach or missed approach). This check is only required on one transmitter.

a. Fly a 10-mile arc through Sectors 1 and 2 (and 3, if procedurally required), at 4,500 ft above the antenna.

b. If clearances are out-of-tolerance, additional checks will be made at decreasing altitudes to determine the highest altitude at which the facility may be used.

217.3211 Coverage. Coverage shall be evaluated concurrently with each required check during all inspections.

217.3212 Reporting Fixes, Transition Areas, SID's/DP's STARs, and Profile Descents. Refer to Figure 217-2. The localizer, SDF, or LDA may be used to support fixes, or departure, en route, and arrival procedures. Transitions may be published through air space which are beyond the localizer, SDF, or LDA service volume. Under these circumstances, navigation is accomplished by using some other facility such as VOR or an NDB. Facility performance of all facilities involved shall be checked to ensure that all coverage parameters are within tolerance.

This shall be done during a commissioning inspection, when new procedures are developed or redescribed, or on appropriate special inspections (e.g., user complaints). When fixes are located within the RHO-THETA FISSV and ILS SSV (see definitions in Section 301), coverage throughout the fix displacement area can be predicted (fix displacement evaluation is not required). If the fix is not contained within the localizer and/or glide slope SSV, an ESV must be established to support the procedure.

(1) Required Coverage

(a) LOC (A) B1 to B2. This requirement is satisfied by service volume validation and need not be repeated.

(b) VOR (B) A1 to B2 (R ? 4.5?). Does not need to be checked if within the VOR/NDB FISSV.

(c) VOR (B) A3 to B4.

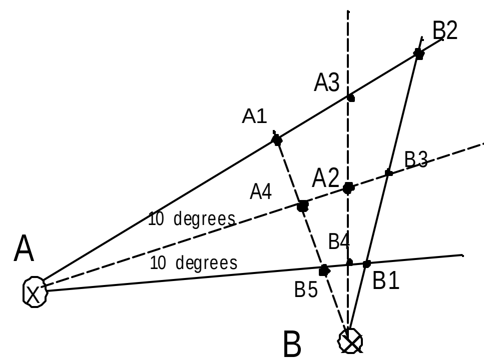
(2) Transitions. When a transition (or missed approach routing) is designed to traverse localizer course Sector 3 or air space which is outside the commissioned service volume, and the transition termination point is not identified with a facility other than the localizer course, check clearance and coverage throughout the entire transition air space at the minimum authorized altitudes. This will normally be an approach segment from a facility or fix to intercept a localizer final approach. An ESV must be established for areas outside the ILS SSV. Termination points not requiring clearance validation are: DME Fixes on transition radial, waypoint, Compass Locator, Lead Radials, fixes made up from other than the localizer, and "Radar Required" fixes. Examples of a transition requiring clearances would be a radial to the localizer only or a radial to a marker beacon on the localizer course.

<u>EVALUATE COVERAGE</u>
LOC (A) B to A2
VOR (B) B to A2

(3) SID's/DP's. Check on-course structure throughout the area of intended use. Check clearance in Sector 1 at the termination point at the minimum authorized altitude.

(4) STARs and Profile Descents. Fly these procedures as proposed or as published. Check facility performance when checking STARs and profile descents in accordance with paragraphs (1) and (2) above, with fixes.

Figure 217-2



217.3213 Polarization Effect. The purpose of this check is to determine the effects that vertical polarization may have on the course structure.

Approved Procedure. This check applies to the front course (and the back course if it is procedurally used), and may be accomplished concurrently with the course structure check. This check is only required on one transmitter.

Fly inbound on-course within unrestricted coverage prior to the FAF and roll the aircraft to a 20? bank left and right. Actuate the event mark at the maximum banked attitude.

217.3214 Identification and Voice. This check is made to ensure identification and voice (if installed) are received throughout the coverage area of the localizer. See paragraph 217.3211.

SDFs have a three-letter coded identifier. Localizers and LDAs have a three-letter coded identifier preceded by the code letter I.

Approved Procedure. This procedure is applicable to the front course (and the back course if it is procedurally used).

Record the identification during all checks. Check voice transmissions when on-course, at the LCA, and at the maximum distance at which course structure is being evaluated.

A localizer shall be restricted if identification cannot be received in all areas of required coverage.

A localizer shall not be restricted solely because the voice/ATIS cannot be received. In this event, advise the procedures specialist and/or air traffic operations personnel.

217.33 Detailed Procedures? Glide Slope.

217.3301 Spectrum Analysis. Reserved.

217.3302 Modulation Level. This check measures the modulation of the radiated signal.

Approved Procedure. Measure the modulation of the glidepath while inbound on the localizer/ glidepath course between 7 and 3 miles from the glide slope antenna with a signal strength of 150 ?V or greater.

217.3303 Modulation Equality. This check establishes the balance of the carrier signals. This check should be made prior to any phasing checks and will be used as the reference for phasing.

Approved Procedure. Have maintenance personnel configure the facility to radiate carrier signal only. When checking capture effect facilities, the primary transmitter radiates this configuration while the clearance transmitter is off or in dummy load.

Use the procedure described in paragraph 217.3302, Modulation Level. While descending, call out the balance to facilities maintenance personnel. Zero ?A is optimum. An imbalance in excess of 5?A shall be adjusted towards optimum.

217.3304 Phasing. This check determines that the correct carrier and sideband-only phase relationship are distributed to the antennas.

a. ***Approved Procedure.*** Phasing may be performed on the ground (by maintenance) or in the air. Consult the appropriate checklist in Paragraph 217.3101. Proceed inbound from 10 miles from the glide slope antenna along the localizer on-course, at 1/3 to 1/2 of the glidepath angle. Maintain this angular descent until reaching runway threshold. Do not make facility adjustments inside 4 miles during the angular descent. Record crosspointer throughout the phasing run. The flight inspection technician should relay the microammeter indications to the facilities maintenance personnel. Have maintenance adjust the phaser until the crosspointer is approximately the same value found during the modulation equality check.

(1) Analysis of Phasing Results. Analyze the crosspointer trace during the descent. If the microammeter value varies from the average between 1/2 mile from the threshold and runway threshold, the antenna offset may be incorrect and should be checked (antenna offset is most accurately established and set by maintenance).

(2) Maintenance Coordination. A comparison of airborne and ground phasing data should be made by maintenance personnel in order to determine if optimum phasing has been established.

b. Null Reference Phasing Make the following checks and phase the facility in the configurations listed below:

Sidebands Radiating in Quadrature to Carrier. Perform the maneuver described in paragraph 217.3304a, Phasing.

c. Sideband Reference Phasing. Make the following checks and phase the facility in the configuration listed below:

(1) Upper Antenna Feed in Dummy Load. Have facilities maintenance personnel insert a 90? section in the main sideband line. Conduct a level run at 1,000 ft above site elevation between 10 to 5 miles from the glide slope antenna. Adjust the phaser to the value found during the modulation equality check.

When phasing is completed, remove the 90? section and check for fully fly-down signal. This indicates that the lower antenna sensing is correct. If full fly-up signal is indicated, sensing is incorrect and the facility must be adjusted.

(2) Radiate Upper and Lower Antennas with a 90-degree Section in the Main Sideband Phaser. Use the procedure described in paragraph 217.3304a, Phasing. Have maintenance adjust the upper antenna phaser to the value found during the modulation equality check. When this value is attained, remove the 90? section from the main sideband line. Ensure that a fly-up signal is received when the aircraft is below the glidepath.

d. Capture Effect. Capture effect glide slopes are normally phased on the ground by maintenance personnel; however, they may request airborne phasing. The airborne phase verification procedure shall be accomplished when requested by maintenance. This procedure confirms that correct phasing has been achieved.

(1) Airborne Phase Verification Procedure. This procedure helps maintenance to determine if proper phasing exists. Both transmitters may be checked if standby equipment is installed.

Airborne Phase Verification Procedures

		PARAMETER						
Steps	Checks	Modulation	Width	Angle	Symmetry	Structure Below Path	Clearance	Path Structure
(a)	Modulation (7)	X						
(b)	Modulation Equality (7)	X						
(c)	Normal Configuration (8)	X	(1)	(2)	X	X	(6a)	X
(d)	Main Sideband Phaser Dephased Advance* Retard* (8)		(3) (3)	(4) (4)		X X		
(e)	Middle Antenna Phaser Dephased Advance* Retard* (8)		(3) (3)	(5) (5)		X X	(6b) (6b)	
(f)	Normal (8)	X	X	X		X		

FOOTNOTES:

(1) Adjust glidepath width to 0.70? ? 0.03?.
(2) Facility shall be adjusted to within 0.05? of commissioned angle for commissioning type inspections.
(3) Width? 0.1? sharper or 0.2? wider than normal.
(4) Angle? ? 0.1?.
(5) Angle? ? .05?.
(6) Clearance? At a fixed angle of 1.0? from 4 miles to runway threshold.
If obstruction clearance is a limiting factor, an acceptable higher fixed angle may be used.

(a) 180 ?A or better.
(b) 150 ?A or better

(7) Maintenance request

(8) Clearance transmitter is energized throughout steps (c) – (f).

Footnotes (3), (4), (5), and (6) are not tolerances; they are results which are expected.

?? Actual degrees advance or retard to be determined by maintenance.

(2) Airborne Phasing. When airborne phasing is requested, use the procedure described in paragraph 217.3304d(2)(a) or (b) below, or other alternate procedures specified by maintenance. Facilities maintenance personnel shall determine which procedure is to be used.

(a) Airborne Phasing Procedure No.1. Confirm that maintenance has established normal carrier sideband ratios and that ground phasing is complete.

NOTE: The clearance transmitter is de-energized throughout steps (1)-(4).

Airborne Phasing Procedure No. 1

Steps	Type Check	Reference Paragraph	Configuration	Unit of Interest
(1)	Modulation Level	217.3302a	Carrier Only	In Tolerance
(2)	Modulation Equality	217.3303a	Carrier Only	Crosspointer 0?A ? 5?A
(3)	Phasing	217.3304a	*Upper to Middle Antenna* Lower Antenna? Dummy Load Middle Antenna? Radiate Carrier + Sidebands Upper Antenna? Radiate Sidebands Main Sideband Phaser? Quadrature	Crosspointer centered about the value found in step (2).
(4)	Phasing	217.3304a	*Lower to Upper and Middle Antenna* Lower Antenna? Radiate Carrier + Sidebands Middle Antenna? Radiate Carrier + Sidebands Upper Antenna? Radiate Sidebands Main Sideband Phaser? Quadrature	Same as above.
(5)	Phase Verification	217.3304d(1) Steps (c)-(f)		

(b) Airborne Phasing Procedure No. 2. This procedure only applies to those facilities in which it is possible to separate carrier and sideband signals in the APCU (Amplitude and Phase Control Unit). Confirm that facilities maintenance personnel have established normal carrier sideband ratios and that ground phasing is complete.

NOTE: The clearance transmitter is de-energized throughout steps (1)-(4).

Airborne Phasing Procedure No. 2

Steps	Type Check	Reference Paragraph	Configuration	Unit of Interest
(1)	Modulation Level	217.3302a	Carrier Only	In Tolerance
(2)	Modulation Equality	217.3303a	Carrier Only	Crosspointer 0?A ? 5?A
(3)	Phasing	217.3304a (See Note a below)	*Lower to Middle Antenna Phasing* Lower Antenna? Radiate Carrier Only Middle Antenna? Radiate Sidebands Only Upper Antenna? Dummy Load Main Sideband Phaser? Quadrature	Crosspointer centered about the value found in step (2).
(4)	Phasing	217.3304a (See Note b below)	*Lower to Upper Antenna Phasing* Lower Antenna? Radiate Carrier Only Middle Antenna? Dummy Load Upper Antenna? Radiate Sidebands Only Main Sideband Phaser? Quadrature	Crosspointer centered about the value found in step (2).
(5)	Phase Verification	217.3304d(1) Steps (c)-(f)		

NOTE: a) Step (3) phasing runs should be accomplished at an elevation angle of 1/2 the glidepath angle (or up to 2/3 of the angle if terrain prevents the lower angle.)

b) Step (4) Phasing runs should be accomplished at an elevation angle equal to the glidepath angle.

217.3305 Engineering and Support Tests. These tests are made at maintenance request, on one transmitter only. Their purpose is to assist the facilities maintenance personnel to make measurements that they are not able to make and/or confirm from the ground.

217.33051 Null Check. The antenna null check is an engineering support check and is not conducted unless requested by engineering/ maintenance personnel. This check is conducted to determine the vertical angles at which the nulls of the individual glidepath antennas occur. It can be conducted on all image array systems. No procedures exist for the non-image arrays.

a. *Approved Procedure*. Use one of the level run methods described in paragraph 217.3306a(1), while the facility is radiating carrier only (sidebands dummy loaded) from one of the antennas. A level run and analysis shall be made for each antenna.

b. Analysis. Compute the angles from the nulls which appear on the recording as dips in the AGC. If the AGC dips are broad, as in the case of the first null of the upper antenna of a capture effect glide slope, angle measurements may have to be accomplished by measuring the second and/or third null.

217.33052 Antenna Offset. This check is performed to establish the horizontal antenna displacements on the mast. Offset affects the phase relationship of the glidepath signal as the aircraft approaches the runway threshold. Low clearances, and/or a fly-down signal between Point B and the runway threshold may be caused by improper offset. Antenna offsets can be accurately determined and positioned by facilities maintenance personnel without flight inspection assistance.

Approved Procedure. Perform a phasing check in accordance with paragraph 217.3304. After optimum results are achieved in the far field (1/2 mile from the runway threshold and beyond), park the aircraft on centerline at the runway threshold. With the facility still in quadrature phase, have facilities maintenance personnel adjust the horizontal displacement in the antennas (the top most antenna should be closer to the runway than the bottom). As the antennas are being adjusted, relay crosspointer indications to the facilities maintenance personnel. The optimum setting is the same as the displacement found during the quadrature phasing checks. Take a final reading when the antenna is secured and personnel are not on the mast. Check the effects of the antenna offset adjustment in the far and near fields by performing another phasing check (217.3304).

NOTE: If the crosspointer is not stable when the aircraft is parked at the runway threshold, then the antenna offset cannot be established on the ground. In this case: (1) have maintenance readjust the antenna offset based on the final phasing run; (2) re-fly the last 3000' from the runway threshold in accordance with paragraph 217.3304a; (3) analyze the results based on paragraph 217.3304a(1).

217.33053 Spurious Radiation. This check is performed to determine if any glide slope signal exists in the final approach segment with the facility configured in dummy load.

Approved Procedure. Fly a low approach on runway centerline, commencing at least 4 miles from the facility. Using a spectrum analyzer or the glide slope receiver traces, compare any signals that are received during the approach with the results found while the facility is transmitting normally.

217.3306 Angle Width, Symmetry, and Structure Below Path. These parameters may be measured from the results of one level run, except when the actual path angle is required (for specific ILS categories and on various types of inspections). In this case, determine the angle by the actual path angle method.

a. Angle. Two methods are used to determine the glidepath angle. They are the level run method, paragraph 217.3306a(1) and the actual path angle method, paragraph 217.3306a(2). The actual path angle method shall be used to measure the path angle during site, commissioning, after-accident inspections, special inspections at maintenance request, and confirmation of out-of-tolerance conditions for Category I glide slopes. It shall also be used during any inspection to determine the reported angle for Category II and III glide slopes. The level run method may be used for measuring the glidepath angle of CAT I facilities subsequent to the commissioning inspection. It should be used for measuring the glidepath angle during monitor checks (for any ILS category), engineering support checks, etc.

NOTE: During any inspection in which actual path angle is measured, the angle found on the level run, in normal configuration, shall be compared to the actual path angle. The difference between these angles shall become a correction factor that shall be applied to all subsequent monitor angles determined by the level run method. Where actual path angle is greater, add the difference to the level run angle; where actual path angle is less, subtract the difference from the level run angle.

Prior to beginning a site or commissioning inspection, obtain the commissioned angle from ground/procedures personnel. Do not change it without their concurrence.

(1) Approved Procedures--Level Run. Position the aircraft beyond the 190uA/150Hz glidepath point on the localizer on-course or procedural designed azimuth. Maintain a constant airspeed. The altitude selected for the level run is usually the GSI corrected to true altitude. However, the selected or GSI altitude may be adjusted due to ATC request, weather, unmeasurable crosspointer transitions, comparability to actual path angle, or a lower altitude to obtain 190?A.

(a) Theodolite Method. Position the theodolite or tracking device in accordance with paragraph 217.25, Theodolite Procedures. Proceed inbound recording 1020Hz reference marks from the theodolite. Measure width, angle, symmetry, and structure below path by referencing the recording at the 190?A/150Hz, 75?A/150Hz, on path, 75?A/90Hz points with the theodolite 1020Hz marks which are usually spaced at 0.2? intervals.

NOTE: An RTT may be used to track an aircraft through the path sector. Apply the path sector width received to the calibration of the RTT.

(b) Altimeter and Ground Speed Method. Fly inbound. Mark checkpoints with the event mark and identify them on the recording. Checkpoints are normally the outer marker and the glide slope antenna; however, any two checkpoints separated by a known distance may be used. A distance for each point (i.e., 190?A, 75?A, 0?A, and 75?A) is determined by using time/distance ratios. The appropriate angle, width, symmetry, and structure below path are calculated from these values.

(2) Approved Procedures--Actual Path Angle.

(a) AFIS Method. See appropriate AFIS manual.

(b) RTT Method. Determine the actual path angle from the straight line arithmetic mean of all deviations of the differential trace occurring in ILS Approach Zone 2. The arithmetic mean can be determined either by using a compensating polar planimeter or by averaging 2-second samples of the deviations in Zone 2 (smaller sampling interval may be used, e.g., 1-second samples).

(c) Standard Theodolite Method. Sufficient positioning information must be obtained to determine the actual path angle, and the presence of bends, reversals, and shorter term aberrations; therefore, more than one run may be required.

b. Width. Path width is the width in degrees of the glidepath width sector. Path width measurements are obtained from level runs (see 217.3306a(1)).

Some facilities have step characteristics of the crosspointer transition which may preclude the use of the 75?A points.

When steps are encountered, the following procedure is recommended to determine which level run measurement points should be used for path width analysis:

(1) Perform a mean width check IAW Paragraph 217.3308.

(2) Fly a normal level run using 60?A measurement points.

(3) Fly a normal level run using 90?A measurement points.

(4) On subsequent level runs, use the measurements points, from (2) or (3) above, which most closely match the path width results measured on the mean width check.

If a point other than 75?A is used to measure path widths, that point shall be used on all subsequent checks and inspections.

c. Symmetry. Symmetry is determined from the data obtained during level run angle and/or width measurements. If points other than the 75?A points are used for measuring the path width, they shall also be used for the symmetry measurements. Symmetry is the balance of the 2 sectors, 90Hz/150Hz. The glidepath should be as symmetrical as possible; however, there normally is some imbalance.

If the level run symmetry is not acceptable, the AFIS, RTT, or theodolite shall be used to determine the mean symmetry (see paragraph 217.3308, Mean Width). Apply the mean symmetry as a correction factor to level runs; annotate on AMIS. If the symmetry still remains out-of-tolerance, the facility shall be removed from service.

d. Structure-Below-Path. This check determines that the 190?A/150Hz point occurs at an angle above the horizontal which is at least 30 percent of the commissioned angle. The structure below path is determined from the data obtained during the level run angle or width measurements. Altitudes lower than GSI may be required to make this measurement.

> **NOTE:** The structure-below-path point does not have to occur within the service volume of the facility to be a valid check, provided the AGC and flag alarm current indications are within appropriate tolerances.

If the 190?A/150Hz point, in any facility configuration, cannot be found, conduct a clearance below path check starting at the edge of the service volume. Apply the appropriate tolerance.

During monitor dephase checks, the structure-below-path angles, as compared to the normal SBP, indicate performance of the below path sensitivity of the glide slope. The information may be used by maintenance for system optimization.

217.3307 Clearance. This check is performed to assure that positive fly-up indications exist between the bottom of the glidepath sector and obstructions. Clearances above the path are checked to ensure that positive fly-down indication is received prior to intercepting the first false path.

a. Approved Procedure.

(1) Clearance Below the Path. Starting at the FAF or GSI distance (whichever is further), fly along the localizer centerline (and the areas specified by the checklists). For glide slopes associated with offset localizers or LDA's, check to Point "C". For the 5 and 8? Endfire checks, check only to Point "B". For all glide slopes with runway centerline localizers, check centerline clearances to runway threshold. Check that the required amount of fly-up signal exists (180?A in normal, 150?A in any monitor limit condition) from the FAF/GSI to the following points:

(a) CAT I not used below 200 ft Decision Height (DH) -- ILS point "C" for an unrestricted glide slope; or the point at which the glide slope is restricted. When clearances are checked to commissioning criteria, document the results as satisfactory or unsatisfactory between Points "C" and "T" on the flight inspection report.

(b) CAT I used below 200 ft DH and all CAT II/III --Runway threshold.

(2) Clearance Above the Path. Check that 150?A fly-down occurs prior to the first false path. Perform this check during the level runs in accordance with the approved procedure, paragraph 217.3306a(1).

217.3308 Mean Width. This check, performed during site evaluation, commissioning, and reconfiguration inspections, is used to determine the mean width of a glidepath between ILS Points "A" and "B". This check may also be used to determine the mean symmetry of the glidepath. Theodolite, RTT, or AFIS shall be used. The path width should be established, as nearly as possible, to 0.7? prior to the check.

Approved Procedure. Fly inbound on the localizer on-course maintaining 75?A above the glidepath between ILS Point "A" and "B". Repeat the same run at 75?A below the glidepath, and again while on the glidepath.

Determine the mean width from the angle found above and below the glidepath and calculate symmetry from the on-path angle.

217.3309 Tilt. This check verifies that the glidepath angle and clearances are within the authorized tolerance at the extremities of the localizer course sector. Apply the actual angle correction factor to the level run angles in the Tilt check.

Approved Procedure. With the glide slope facility in normal, measure clearances below the path at the localizer 150 ?A point either side of centerline from the GSI to Point B. At the GSI altitude, measure the path angle, modulation, and clearance above path, at the localizer 150 ?A point either side of centerline, using the level run method. This check is only required on one transmitter.

217.3310 Structure and Zone 3 Angle Alignment. These checks measure structure deviations and Zone 3 angle alignment. Measurements are made while the facility is operating in a normal configuration, except for special structure evaluations on waveguide facilities.

a. ***Approved Procedure.*** Fly inbound on the glidepath and localizer course from 10 miles from the glide slope antenna or glide slope ESV (whichever is greater) through all zones. The structure shall be evaluated in all zones and the CAT II and III angle alignments in Zone 3. Angle alignment shall be evaluated using the RTT or AFIS. The angle alignment (or deviation of the mean angle from Point B to Point T) is affected by siting, phasing, and antenna offset factors that may not affect the measured Zone 2 angle.

b. Inspections.

(1) During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change, evaluate the structure by using the entire procedure described in paragraph a above.

(2) During all other inspections (i.e., periodic, periodic with monitors, etc.) this evaluation can be accomplished from the GSI or FAF (whichever is further) by using the procedure described in paragraph a above.

217.3311 Transverse Structure--Endfire Glide Slope. This is a measurement of the horizontal structure of the glidepath and is directly related to on-path structure, tilt, and clearance. On any inspection after commissioning, where transverse structure is checked, compare the course and clearance normal results with those from the last results on file. Notify maintenance of any significant changes. Perform a tilt check on the affected side(s) if the glide slope microamp deflection at the localizer 150 ?A point exceeds angle tolerances.

a. Approved Procedure. Fly an arc of at least 12? each side of localizer centerline at the FAF distance and FAF altitude corrected to true altitude. The arc shall be referenced laterally to localizer centerline abeam the glide slope antenna. If the FAF is less than 5.0 miles from the glide slope, the arc distance shall be changed to at least 5 miles. (*As the received glidepath is affected by aircraft distance and altitude, it is critical that these parameters do not vary during the arc.)* The arc may be flown either clockwise or counter-clockwise. Record both localizer and glide slope crosspointers: The glide slope should be calibrated to 150?A to ensure proper trace definition. The localizer should be calibrated to enable the technician to identify the 150?A points. Using FAA Form 8240-19, plot all "as left" transverse structure configurations, to include those done at maintenance request.

b. Analysis. No tolerance is applied to transverse structure, but the following results are expected. Results exceeding the expected values will require engineering analysis prior to final resolution. Results of these checks are used by engineering to adjust antenna pedestal locations and signal levels. Multiple runs may be required to optimize the antenna arrays. See Figure 217-3 for a sample plot.

(1) Within the localizer course sector, the change of the glide slope signal should not exceed *64?A of 150 Hz or *48?A of 90 Hz from the crosspointer value found on the localizer on-course. *This analysis applies to a 3.0? commissioned glide slope angle. See the following table:

+10%/-7.5% ANGLE ALARM/TRANSVERSE STRUCTURE MICROAMP VALUE

Commissioned Angle	Low Angle (?/? A)	High Angle (?/? A)
2.5?	2.32?/ 38 ?A (90 Hz)	2.75?/ 53 ?A (150 Hz)
3.0?	2.78?/ 48 ?A (90 Hz)	3.30?/ 64 ?A (150 Hz)
3.5?	3.24?/ 55 ?A (90 Hz)	3.85?/ 75 ?A (150 Hz)

(2) From the edge of the localizer course sector to 8? from the localizer on-course, signals should not exist that are greater than 48?A in the 90 Hz direction from the glide slope crosspointer value found on the localizer on-course.

217.3312 Coverage. Coverage shall be evaluated concurrently with each required check during all inspections.

217.3313 Monitors. The purpose of these checks is to measure glidepath parameters when the facility is set at the monitor reference. The inspector shall ensure that the facility is set at the monitor reference prior to each check. Monitor references shall be checked IAW paragraph 217.31c when prescribed by the checklist, and when applicable on special inspections.

At the conclusion of any monitor inspection, the facility shall be returned to normal, and the following checks performed and results reported: Angle, Width, Symmetry, and Structure Below the Path, 217.3306.

a. ***Approved Procedure*****.** Use the level run method (paragraph 217.3306a(1)) to measure width, angle, and structure below the path in the monitor limit conditions. Check clearances in accordance with 217.3307.

b. Inspections--Periodic with Monitors. There is no requirement to check the facility in normal prior to conducting the monitor check.

217.3314 RF Power Monitor Reference. This check is conducted to determine that the glide slope meets specified tolerances throughout its service volume while operating at reduced power.

a. Approved Procedure. The glidepath transmitter shall be placed in reduced power setting for this check (both primary and clearance transmitters for capture effect and endfire glide slopes). This check shall be made on the localizer on-course and 8? on each side of the localizer on-course.

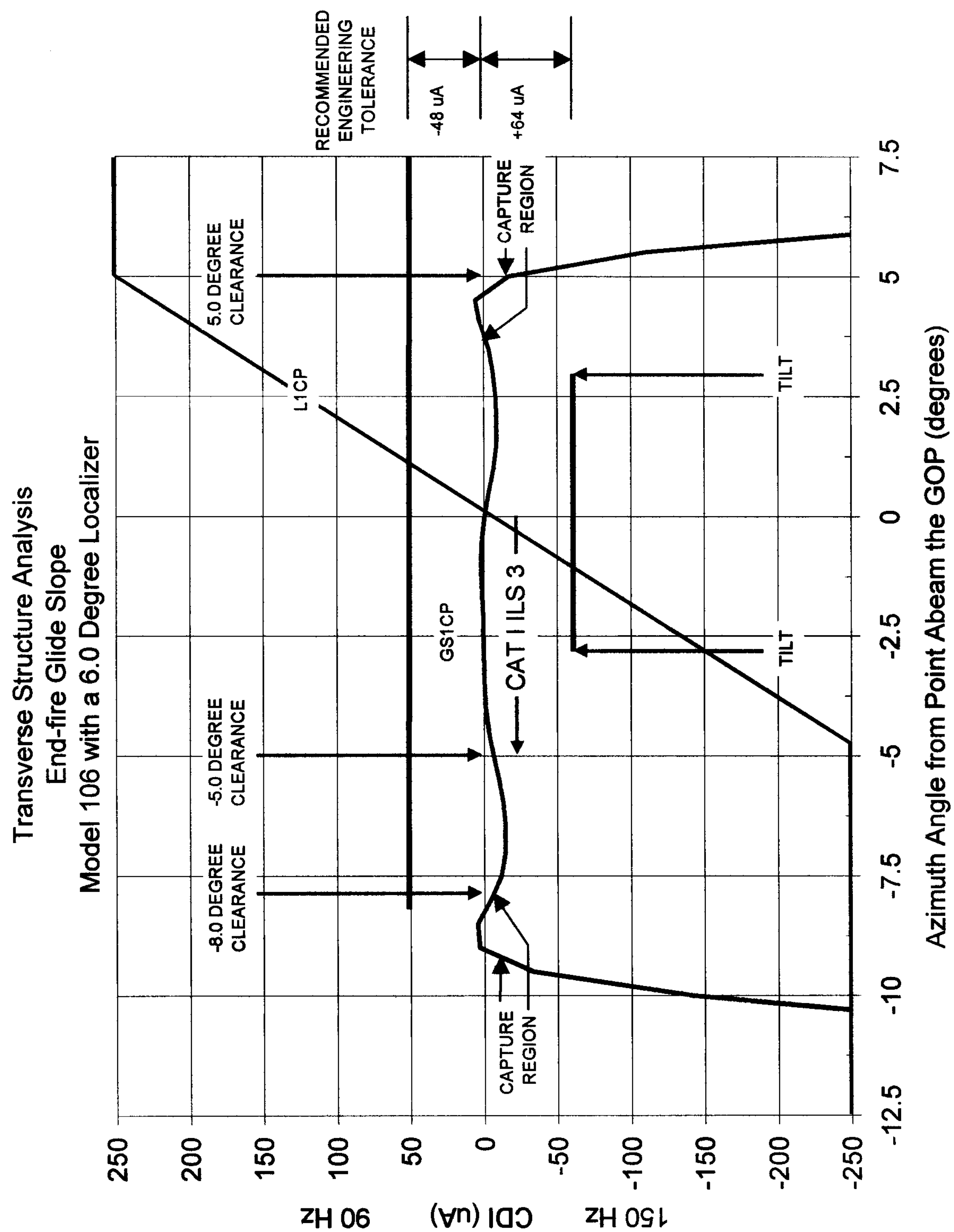
(1) While maintaining the LCA, fly inbound from 10 nm from the facility to the interception of the lower sector of the glidepath (i.e., the point nearest the glidepath at which 150?A occurs). Fly through the glidepath sector and check clearances above the path.

(2) In situations where the GSI intersects the glidepath at a distance that provides less than 150?A fly-up signal, descend to an altitude which will provide at least 150?A fly-up while providing adequate obstacle clearance at 10 miles or ESV (whichever is further).

(3) To validate an ESV, calculate the altitude at 0.45 times the commissioned angle at the ESV distance. Use that altitude to fly the checks listed above, starting no closer than the ESV distance. The ESV checks replace the standard 10-mile checks.

b. Endfire. The endfire glide slope antenna array is orientated toward the runway. The normal fly-up/fly-down signal ends at approximately 5? on the antenna side of the runway; therefore, you will have only 150 Hz clearance signal at 8? on the antenna side of the runway. The provisions of Paragraph 217.44 will apply to this situation.

Figure 217-3


Transverse Structure Analysis
End-fire Glide Slope
Model 106 with a 6.0 Degree Localizer
RECOMMENDED ENGINEERING TOLERANCE
-48 uA
+64 uA
5.0 DEGREE CLEARANCE
-5.0 DEGREE CLEARANCE
-8.0 DEGREE CLEARANCE
CAPTURE REGION
CAPTURE REGION
L1CP
GS1CP
CAT I ILS 3
TILT
TILT
90 Hz
CDI (uA)
150 Hz
250
200
150
100
50
0
-50
-100
-150
-200
-250
-12.5
-10
-7.5
-5
-2.5
0
2.5
5
7.5
Azimuth Angle from Point Abeam the GOP (degrees)

217.34 General.

217.3401 Standby Equipment - Localizer/ Glide Slope. Where dual equipment is installed, complete all checklist items for both sets of equipment, except as noted in the text of this section, and the checklists.

217.3402. Standby Power - Localizer/Glide Slope. Refer to paragraph 106.43; if the check is required, make the following checks while operating on standby power.

a. Localizer. Course width, alignment, symmetry, modulation, and identification.

b. Glide Slope. Modulation, width, angle, symmetry, and structure below the path.

217.3403 Expanded Service Volume (ESV). Where an operational requirement exists to use either or both the glide slope and localizer to altitudes and/or distances beyond the normal service volume, the facility(ies) shall be inspected to the expanded altitudes and/or distances (in accordance with 217.3209 and 217.3314) to determine that facility performance for the required parameters meets tolerances. Place particular emphasis on signal strength, interference, clearances, and structure.

If a localizer or glide slope cannot support ESV requirements, the ESV shall be denied. The facility shall not be classified as restricted solely because it fails to support the ESV.

a. Localizer. The localizer Standard Service Volume (SSV) is depicted in Figure 217-6. Use beyond these limits requires an ESV approved by spectrum management and validated by flight inspection. The two most common ESV's are those to support transitions IAW para 217.3212(2) and those to support localizer interception at greater than normal distances. In either case, the validated minimum altitude in the ESV area may be higher than the LCA within the SSV. These minimum altitudes, as well as the maximum authorized, must be specifically documented on the flight inspection report and the facility data sheet.

b. Glide Slope. The glide slope SSV is depicted in Figure 217-7.

217.35 Supporting NAVAID's. These may consist of marker beacons, a compass locator, DME, and/or lighting systems. Additionally, some locations may require other types of NAVAID's to support the approach procedures. Verify RHO-THETA crossing radials associated with an ILS approach IAW Paragraph 201.3211.

217.36 Instrument Flight Procedures. See Section 214.

217.4 Analysis. A detailed analysis of the measurements and calculations made during the course of the flight inspection provides an overall picture and permanent record of facility performance.

217.41 Structure Tolerances (95% Rule). Application of course structure analysis contained in this paragraph applies to all zones (1, 2, 3) of glidepaths and all zones of localizers (1, 2, 3, 4, & 5) and SDF's, including back courses. This provision does not apply to glide slope rate of change/reversal (see Paragraph 217.42). For Category II/III facilities, the applicable region or military command engineering staff must be notified of initial application of this criteria. If course or path tolerances are exceeded, analyze the course/path structure as follows:

a. Where course/path structure is out-of-tolerance in any region of the approach, the flight recordings will be analyzed in distance intervals of 7,089 ft (1.17 nm) centered about the region where the out-of-tolerance or aggregate of out-of-tolerance condition(s) occurs. Two 7,089 ft areas shall not overlap.

b. Where necessary to avoid overlap, centering the interval about the out-of-tolerance region may be disregarded.

c. It is not permissible to extend the 7,089 ft segment beyond the area checked, i.e., service volume or ESV, whichever is greater, or the point closest to the runway where analyzation stops.

d. The course/path structure is acceptable if the aggregate structure is out of tolerance for a distance equal to or less than 354 ft within each 7,089 ft segment.

217.42 Rate of Change/Reversal in the Slope of the Glidepath. The following analysis of the path angle recording shall be accomplished during all inspections where AFIS, RTT, or other tracking devices are being used. It applies to all categories of ILS.

a. Inspect the glidepath corrected error trace/differential trace in Zones 2 and 3 for changes and/or reversals in the trend of the slope of the path trace.

b. Determine if the trace (or trend), on either or both sides of the point where a change in direction occurs, extends for at least 1,500 ft along the approach with an essentially continuous slope (see Figure 217-5).

c. If one or more changes/reversals meets the condition in b. above, draw a straight line through the average slope that covers at least a 1,500 foot segment each side of the point of change. It is permissible to extend the straight line of the average slope to inside Point C if required, in order to obtain the 1,500 foot segment. Determine the change-in-slope by measuring the divergence of the two lines at a point 1,000 ft from their intersection.

d. NOTAM Action. The use of facilities which do not meet the change/reversal tolerance shall be limited by a NOTAM (see Paragraph 107.34k) that withholds authorization for autopilot coupled approaches below an altitude (MSL) which is 50 ft higher on the glidepath than the altitude at which the out-of-tolerance condition occurs. Compute the MSL altitude for such a restriction based on the commissioned angle of the facility.

(1) Category I facilities that do not meet the change/reversal tolerance shall not be classified "restricted" due to the change/reversal. However, NOTAM action shall be taken and the National Flight Procedures Office advised.

(2) Category II and III facilities are required to meet the established change/reversal criteria. If a change/reversal is found, the facility shall be classified "restricted" and the Cat II/III procedures NOTAM'd. Additional NOTAM action per Paragraph 107.34k also applies.

217.43 Application of Localizer Coverage Requirements. The maneuvering areas described in the approved procedures of this section define the standard service volume in which coverage tolerances shall be maintained in order for a localizer to be assigned a facility classification of "UNRESTRICTED". The localizer may still be usable when coverage does not meet tolerances throughout the standard service volume, depending on the effect of the restriction on procedural use. In evaluating such effects, all coverage criteria must be considered; however, for an UNRESTRICTED classification, the following criteria must also be met:

a. Clearances

(1) Tolerance Application. Deviations in any sector to less than 100?A are not acceptable. In Sectors 2 and 3, momentary deflections of the crosspointer to less than the tolerances are acceptable, provided that the aggregate area does not exceed 3? of arc in Sectors 2 and 3 combined in one quadrant. Such an area is acceptable on both sides of the localizer. Additionally, all the above criteria are applicable to the back course.

NOTE: One quadrant is defined as that area between the localizer on-course and a point 90° to the antenna.

(2) Restrictions. If a localizer is restricted in Sector 2, it shall not be used for a procedure turn on the restricted side, unless the inbound procedure turn course guidance is provided by some other facility, such as a VOR, NDB, etc.

(3) Momentary deviations of the Localizer cross pointer in Sector 1 can be averaged without further evaluation, provided the cross pointer deviation does not present a noticeable effect on flyability or create a possible false course. Questionable reversals of trend or excessive irregular flattening of the course ("steps") require an evaluation of the effect on the procedure. When this condition occurs, refly the sector 1 arc on one transmitter at the service volume limit at LCA at a maximum ground speed of 170 knots. Evaluate for noticeable effects on flyability and possible false course indications. The procedure shall be removed if reversals of trend exceed 10?A or flyable false course indications occur. If the arc at LCA is satisfactory for flyability, document the check on the facility data sheet, e.g., "Deviations in sector 1 clearance linearity evaluated on the front course/back course (as appropriate) and the results found satisfactory IAW 8200.1A, paragraph 217.43; Date mm/dd/yr."

b. Distance Requirements.

(1) Restrictions to localizer coverage at distances less than the standard service volume are permitted, provided the localizer meets all coverage tolerances throughout all procedural approach segments and at the maximum distance at which the procedure turn may be completed.

(2) Restrictions above the LCA are acceptable, provided a step-down fix, etc., can be added to the appropriate approach segment which restricts descent to within the altitude/distance at which acceptable coverage at the LCA was achieved.

c. Vertical Angle Requirements.

(1) If in-tolerance coverage cannot be maintained up to 7? or point C as required by step 5 in the RF power monitor check, the localizer may still be used for CAT I and nonprecision operations on a restricted basis; however, the localizer shall be classified as "unusable" if in-tolerance coverage cannot be maintained up to 4? or 1? greater than the commissioned glidepath angle, whichever is greater (both measured from the localizer).

(2) If vertical angle coverage is limited but the localizer can be used on a restricted basis as outlined above, a NOTAM shall be issued which restricts the localizer as "unusable" above a specified altitude, both at the threshold and at least one other point, usually the FAF (see example in Section 107). Note the angle at which unsatisfactory coverage occurred and evaluate its effect on the nonprecision MDA, maximum holding altitudes, and missed approach instructions/ protected areas.

217.44 Application of Glide Slope Coverage Requirements. The RF Power Monitor check described in Paragraph 217.3314 defines the lateral and longitudinal standard service volume of the glide slope. The approved procedure specifies to check for clearances above the path. If there is no defined glidepath or clearance above path, the glide slope shall be restricted as unusable beyond a point referenced angularly to runway centerline at which no glidepath or clearance above path is provided. See an example in Section 107. The glide slope shall meet the tilt tolerance and the RF power monitor tolerance.

217.45 ILS Maintenance Alert. Facilities serving the National Airspace System (NAS) and U.S. Air Force facilities not serving the NAS shall be provided an ILS maintenance alert as follows:

a. An ILS maintenance alert shall be provided by flight inspection following a normal periodic check without monitors when a measured flight inspection parameter exceeds 60 percent of the flight inspection tolerance. This applies to the following critical monitored parameters:

(1) CAT I/II Localizer course widths

(2) Localizer alignment

(a) CAT I ILS, Localizer only, and SDF's aligned along runway centerline ? 9?A

(b) CAT II ? 6 ? A

(c) Offset localizers, Offset SDF's, LDA's, and Independently Monitored Back Courses ? 12 ? A

(d) Other Back Courses ? 39 ? A

(3) Glide slope path widths ? 0.58? / ? to 0.82?

(4) CAT I/II Glide Slope Angles

b. The flight inspector shall forward the ILS maintenance alert results by FAX or telephone (when FAX is unavailable) to the central scheduling and dispatch facility.

The central scheduling and dispatch facility shall enter the results on FAA Form 8240-7-1, Appendix 11, FAA Order 8240.36 (current version) and forward the results by FAX or telephone (when FAX is unavailable) to the regional maintenance engineering branch within 24 hours. For U.S. Air Force facilities, notify the appropriate Major Command (MAJCOM) headquarters. When the results are forwarded by telephone, enter the name of the person contacted in the remarks block on FAA Form 8240-7-1, which shall be forwarded to the regional maintenance engineering branch.

c. When a measured flight inspection parameter exceeds the flight inspection tolerance, if AF maintenance is available and on site, request an evaluation of the parameter that has exceeded tolerance and determine whether it can be corrected. If the parameter that exceeded tolerance is corrected, leave the facility in service. If not, remove the facility from service and issue a NOTAM.

217.46 Glide Slope Snow NOTAM. During periods of heavy snow accumulation, Airway Facilities personnel may NOTAM glide slope facilities as "due to snow on the XXX (appropriate identifier), glide slope minima temporarily raised to localizer only." Category II/III operations are not authorized during the snow NOTAM. The following guidance is to be followed when an ILS is scheduled for a periodic inspection when a snow NOTAM is in effect and the flight inspection window is exceeded. Localizer flight checks shall be conducted as normally scheduled. Glide slope flight checks shall be accomplished dependent upon the following conditions:

a. If the NOTAM indicates localizer only for all categories of aircraft, then an approach evaluation shall be made to determine angle and structure. All out-of-tolerance conditions shall be reported to maintenance. After the snow NOTAM is canceled, flight inspection of the glide slope will be in accordance with paragraph 105.2. Enter "PI" in Block 21, Type of Check, on FAA Form 4040-5, Flight Inspection Daily Flight Log. In the "Remarks" section of FAA Form 4040-5, indicate, "Snow NOTAM in effect at time of inspection, no discrepancy assigned."

b. If the NOTAM indicates glide slope minima raised to localizer only for Category D aircraft, follow the procedure outlined in paragraph 217.46 above--the only exception being that any out-of-tolerance condition shall generate a discrepancy and the appropriate NOTAM. Restoration flight check shall be scheduled as an "Unscheduled Special (U)."

c. If the glide slope supports Category II/III approach procedures, the glide slope will only be evaluated to Category I tolerances. Restoration of Category II/III facilities, after the snow NOTAM is removed, will be considered as a periodic overdue inspection in accordance with paragraph 105.2.

d. Monitor check shall not be accomplished while the snow NOTAM is in effect. Flight inspection after the snow NOTAM is canceled shall be considered as a periodic overdue in accordance with paragraph 105.2.

e. If the approach is satisfactory, a Category I periodic check will be complete when a level run to check width and symmetry is accomplished and no out-of-tolerances are found. Entries on FAA Form 4040-5 shall be normal.

217.47 CAT III Adjust and Maintain. Localizer width/alignment and glide slope angle checks on Category III ILS systems are required to be maintained at tighter than monitored values. Results that exceed these values, but do not exceed flight inspection tolerances IAW Paragraph 217.5, should not be considered out-of-tolerance, and no discrepancies should be noted on the Daily Flight Log.

a. Inspections Not Involving Maintenance Personnel. When CAT III facilities are found operating beyond these tighter values, repeat the run(s) to confirm the measurement and, if repeatable, advise maintenance immediately.

(1) If maintenance is unable to respond and make adjustments, document the circumstances on the flight inspection report. A maintenance alert shall be issued IAW Paragraph 217.45. The facility shall remain CAT III unless downgraded by maintenance.

(2) If maintenance is available, remain on-station to check the adjusted parameters and document the circumstances on the flight inspection report. Issue a Maintenance Alert IAW Paragraph 217.45. For inspections Requiring Maintenance Personnel, do not leave the facility operating CAT III beyond the "Adjust and Maintain" values.

(3) Adjust and Maintain Values:

Localizer Alignment	? 4?A
Localizer Width (Commissioned Width)	? 10%
Glide Slope Angle (Commissioned Angle)	? 4%

217.48 Threshold Crossing Height (TCH)/ Reference Datum Height (RDH).

a. CAT I. FAA Order 8260.3, TERPS Instrument Procedures, limits the CAT I procedural TCH to a maximum of 60 ft. Minimum TCH varies per the wheel crossing height of the user aircraft. TCH is normally determined by procedures personnel and is not evaluated by flight inspection. If FAA Order 8240.47, Determination of ILS Glidepath Angle, RDH, and Ground Point of Intercept (GPI), is applied to a CAT I facility, the flight check derived RDH replaces procedural TCH.

NOTE: IAW Order 8240.47, specific requirements must be met prior to application of that order.

b. CAT II/III. FAA Order 8240.47 shall be applied.

(Manual Analysis of Raw Data)

Figure 217-4

APPLICATION OF STRUCTURE TOLERANCE -- CAT. II & III

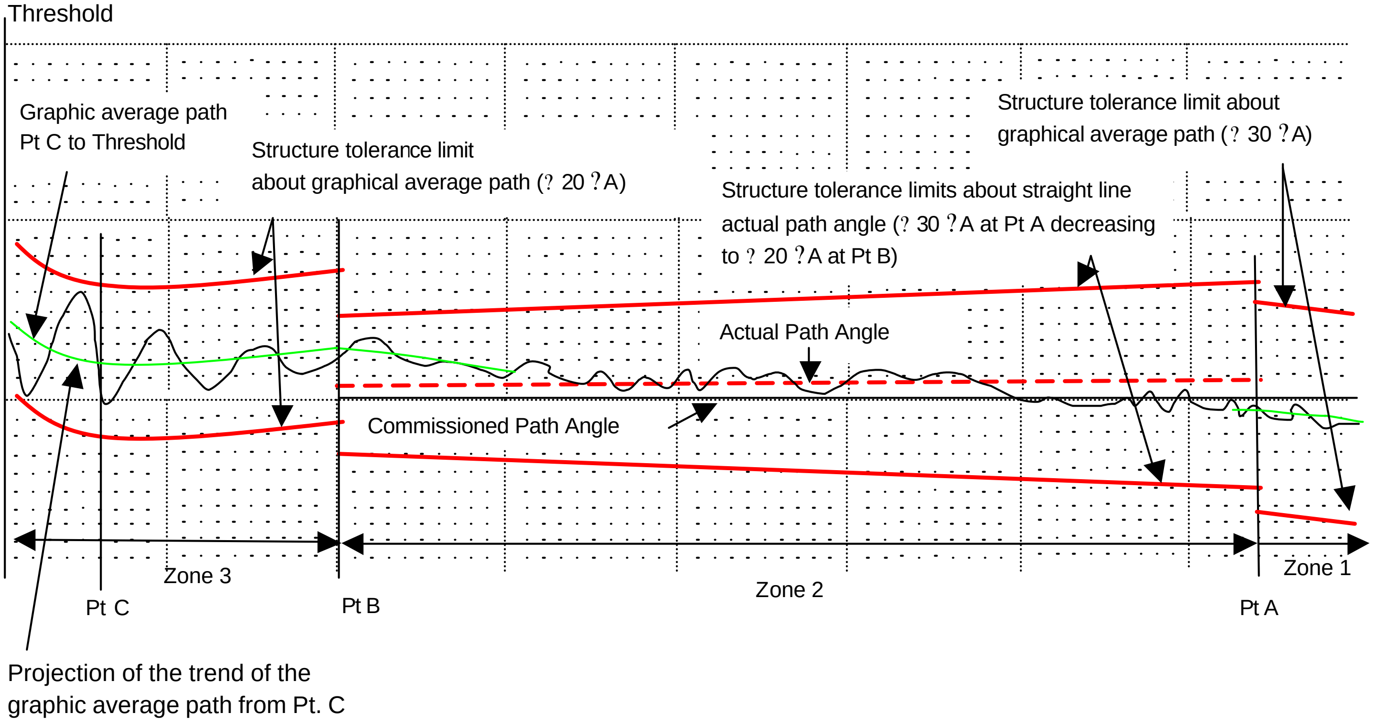
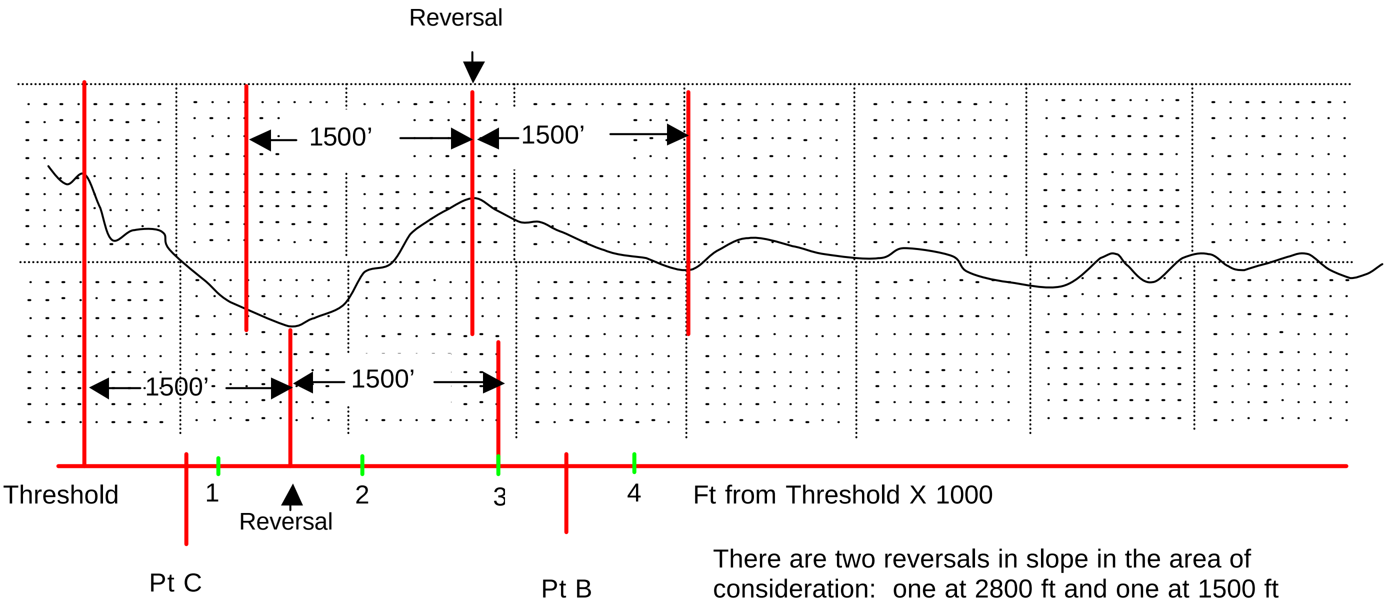


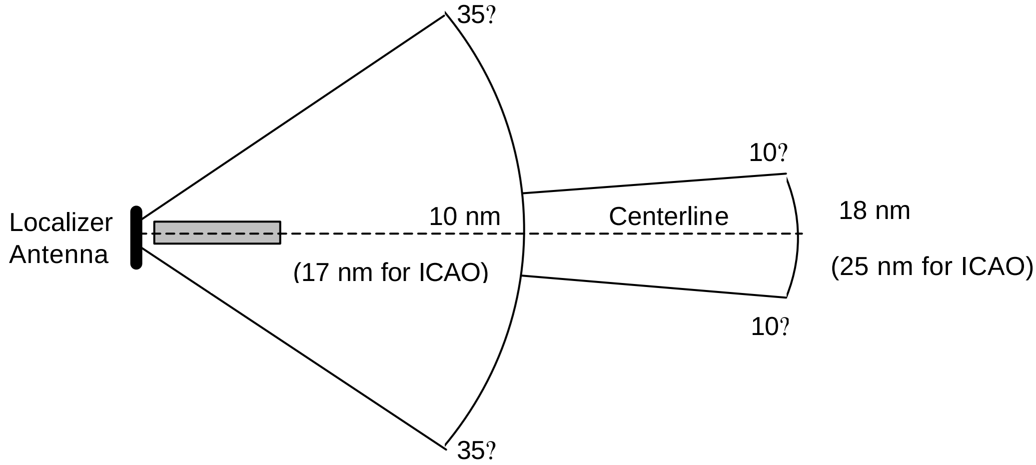
Figure 217-5

RATE OF CHANGE/REVERSAL IN THE SLOPE OF THE GLIDE PATH



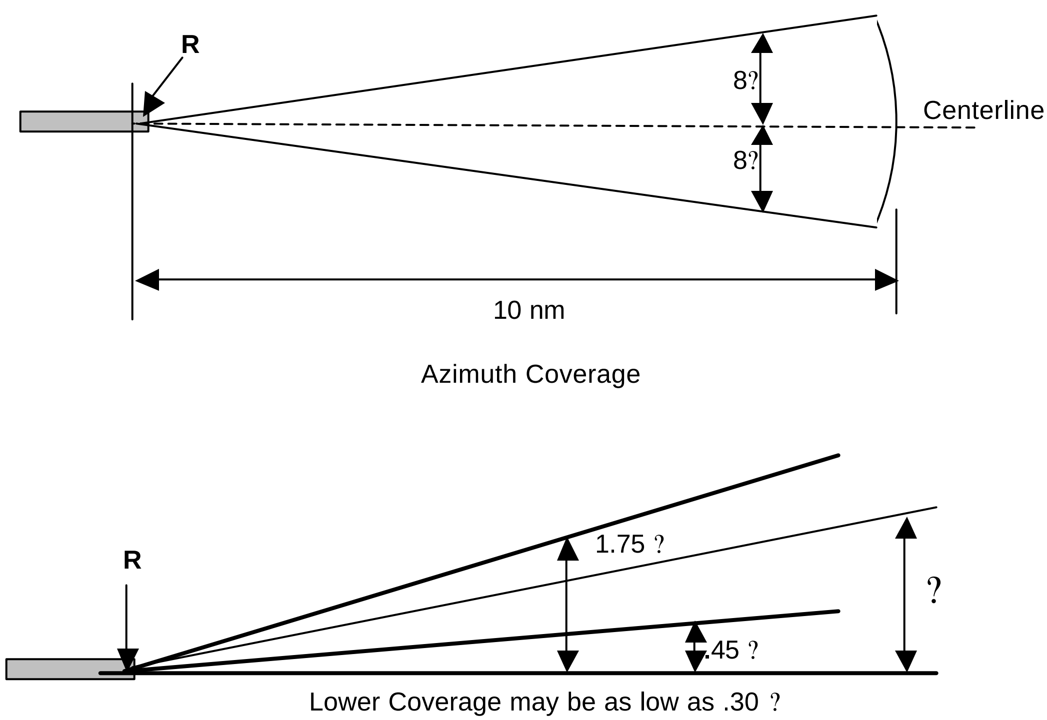
There are two reversals in slope in the area of consideration: one at 2800 ft and one at 1500 ft from the threshold. Each reversal meets the requirement that the slope or trend on at least one side of the break extends for at least 1500 ft.

FIGURE 217-6
LOCALIZER STANDARD SERVICE VOLUME



Front or Back Course

Figure 217-7
GLIDE SLOPE STANDARD SERVICE VOLUME



Lower Coverage may be as low as .30 ?

R = Point where downward extended glide slope intersects runway centerline.
? = Glide Path Angle

217.5 TOLERANCES.

CODES:

C ? Tolerances that are applied to site, commissioning, reconfiguration, and categorization inspection.

P ? Tolerances that are applied to any inspection subsequent to the inspections outlined in Code C.

a. Localizers.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Spectrum Analysis	Reserved			
Modulation Level	217.3202	X	X	36 – 44% as measured IAW 217.3202 30% - 60% throughout the service volume of all localizers installed or reconfigured with new type antennas after 01/01/2000. For existing systems, note in the flight inspection report areas where modulation exceeds 60%. For two-frequency systems, the standard for maximum modulation percentage does not apply at or near azimuth where the course and clearance signal levels are equal in amplitude (i.e., at azimuths where both transmitting systems have a significant contribution to the total modulation percentage).
Waveguide Clearance XMTR		X	X	36 – 44% as measured IAW 217.3202
Power Ratio	217.3204	X		The course transmitter power level shall be at least 10 dB greater than the clearance transmitter.
Phasing	217.3205	As Required		No tolerance.
Width?	217.3206			Maximum? 6.0? (SDF-12.0?). CAT II & III tailored to 700 ft. Precision approach? 400 ft minimum course width at the threshold.
Front Course		X		? 0.1? of the commissioned width.
			X	Within 17% of the commissioned width.
Transmitter Differential (Front Course)			X	The difference in the normal widths shall not be greater than 0.5? or 10% of the commissioned width, whichever is least.
Back Course	217.3206	X		Between 3.0? and 6.0?
			X	Between 2.49? and 7.02? in normal or monitor alarm condition.
		X	X	SDFs ? Within 10% of the front course sector width.
Symmetry (Front Course Only)	217.3206	X	X	With the facility in normal: 45-55%.
Alignment	217.3207			
Front Course and Independently Monitored Back Courses		X		Within ? 3 ?A of the designed procedural azimuth.
			X	For ILS's, Localizer-only on centerline and SDFs on centerline. From the designed procedural azimuth: CAT I ? 15 ?A. CAT II ? 11 ?A. CAT III ? 9 ?A. Offset Localizers, LDAs ? 20?A Offset SDFs ? 20 ?A. Back Course ? 20 ?A.
Back Course (Facilities subordinate to front course.)		X	X	Designed procedural azimuth ? 65 ?A.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Course Structure Front Course	217.3207	X	X	Zone 1? From the graphical average course: CAT I, II, III: ? 30 ?A to Point A SDF: ? 40 ?A to Point A
NOTE 1: Use CAT I tolerances for offset localizers, localizer only, and LDAs. NOTE 2: For localizer only, LDA, SDF, measure structure from graphical average course				Zone 2? From the actual course alignment: CAT I: ? 30 ?A at Point A; linear decrease to ? 15?A at Point B. CAT II, III: ? 30 ?A at Point A; linear decrease to ? 5?A at Point B, SDF: ? 40 ?A at Point A; linear decrease to ? 20?A at Point B. Zone 3? From the actual course alignment: CAT I: ? 15 ?A at Point B; ? 15?A at Point C. SDF: ? 20 ?A at Point C.
	217.3207			Zones 3 & 4? From the actual course alignment. CAT II, III: ? 5 ?A at Point B; ? 5 ?A to Point D. Zone 5? From the actual course alignment. CAT III: ? 5 ?A at Point D; linear increase to ? 10 ?A at Point E.
Back Course		X	X	Zone 1? From the graphical average course: ? 40 ?A to Point A. Zone 2? From actual course alignment: ? 40 ?A at Point A; linear decrease to ? 20 ?A at Point B. Zone 3? From actual course alignment ? 20 ?A at Point B; ? 20 ?A at Point C.
Front and Back Course	217.41	X	X	Exception: An aggregate out-of-tolerance condition for 354 ft may be acceptable in a 7,089-foot segment.
Monitors Alignment Front Course Facilities aligned along the runway	217.3208	X	X	The course alignment monitor shall alarm when the actual course alignment signal shifts from the designed procedural azimuth by no greater than: CAT I ILS and SDFs aligned along runway centerline ? 15 ?A CAT II ? 11 ?A CAT III ? 9 ?A.
Offset Localizers, Offset SDFs, and LDAs	217.3208a(1)(c)	X	X	? 20 ?A from the designed procedural azimuth when using actual course alignment references, i.e., AFIS, theodolite, etc..
Localizers, SDF's, and LDA's where alignment is determined to be satisfactory by visual observations		X	X	±20*u*A from established equality of modulation reference.
Width Front Course & Independently Monitored Back Courses		X	X	Not more than ? 17% of the commissioned width.
Back Course		X	X	2.49 – 7.02?
RF Power	217.3209	X		Maintained at or above: Signal Strength? 5 ?V Flag Alarm? No Flag or indication of invalid signal Clearance and Structure? in tolerance.
Coverage	217.3211	X	X	At or greater than: Signal Strength? 5 ?V Flag Alarm? No Flag or indication of invalid signal Clearance and Structure ? in tolerance Interference? shall not cause an out-of-tolerance condition.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Clearances (Front and Back Course) Facility in Normal configuration Facility in any alarm configuration	217.3210 217.43	X X X	X X X	As measured from the procedural designed azimuth: <u>Sector</u> <u>Minimum Clearance</u> 1 Linear increase to 175 ?A then maintain 175 ?A to 10?. 2 150 ?A (see note). 3 150 ?A (see note). Clearances are reduced 15 ?A from the clearance required in normal. NOTE: Exceptions are authorized in Sectors 2 and 3.
Polarization	217.3213	X	X	Polarization error not greater than: CAT I ? 15?A CAT II ? 8?A CAT III ? 5?A
Identification and Voice	217.3214	X	X	Clear, correct; audio level of the voice equal to the identification level. The identification shall have no effect on the course. Voice modulation shall not cause more than 5?A of course disturbance.

b. Glide Slopes.

PARAMETER	REFERENCE	INSPECTION C	INSPECTION P	TOLERANCE/LIMIT
Spectrum Analysis	Reserved			
Modulation Level	217.3302	X 	 X	78 – 82% 75 – 85%
Modulation Equality	217.3303	As Required		Zero ?A ? 5?A
Phasing and Airborne Phase Verification	217.3304	As Required		No Tolerance
Engineering & Support Tests	217.3305 217.33051 217.33052 217.33053 217.3311	As Required		No Tolerance
Width	217.3306b	X 	 X	0.7? ? 0.05? (Site Survey, USAF test van: 0.7? ? 0.1?) 0.7? ? 0.2?
Angle	217.3306a(2) 217.3306a(1)	X 	 X	Within ? 0.05? of the commissioned angle. (Site Survey, USAF test van: ? 0.1? of the commissioned angle) Within + 10.0% to -7.5% of the commissioned angle.
Transmitter Differential	217.3306a	X 	 X	? 0.10? ? 0.20?
Alignment	217.3310	X	X	CAT I ? Not applicable CAT II and III (Also CAT I authorized use below CAT I minima) Zone 3 ? 37.5 ?A about the commissioned angle at Point B; expanding linearly to ? 48.75 ?A about the commissioned angle at Point C; expanding linearly to ? 75 ?A about the commissioned angle at ILS reference datum.
Tilt	217.3309	X	X	Within + 10.0% to -7.5% of the commissioned angle. Clearance Above Path, Modulation Clearance Below Path - 180?A
Reference Datum Height (RDH)	217.48	X		CAT I: Maximum 60 ft CAT II and III: 50 to 60 ft. (Also CAT I authorized use below CAT I minima)
Symmetry	217.3306c	X	X	The following criteria are applied with the facility in a normal configuration: CAT I 67-33%. Broad sector either above or below path. CAT II 58-42%. Broad sector either above or below path. 67-33% If broad sector below path only (Also CAT I authorized use below CAT I minima) Cat III 58-42%. Broad sector either above or below path.
Structure below Path	217.3306d	X	X	190?A of fly-up signal occurs at an angle which is at least 30% of the commissioned angle.
		X	X	Exception: If this tolerance cannot be met, apply clearance procedures and tolerances.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Clearance Below the Path	217.3307	X	X	Adequate obstacle clearance at no less than 180?A of fly-up signal in normal (150?A in any monitor limit condition).
Above the Path		X	X	150?A of fly-down signal occurs at some point prior to the first false path.
Structure	217.3310 217.41 217.42			
With AFIS or Tracking Device.		X	X	
Zone 1 2 3				Category 1 30?A from graphical average path. 30?A from actual path angle. 30?A from graphical average path
Zone 1 2 3				Category II and III (Also CAT I authorized use below CAT I minima) 30?A from graphical average path. From actual path angle 30?A at Point A, then a linear decrease to 20?A at Point B. 20?A from the graphical average path
Without AFIS or tracking device	217.23		X	
Zone 1 2 3				Category 1 30?A from the graphical average path. 30?A from the graphical average path. 30?A from the graphical average path.
	217.41	X	X	Exception: An aggregate out-of-tolerance condition for 354 ft may be acceptable in a 7,089-foot segment.
Change/Reversal	217.42	X	X	25?A per 1,000 ft in a 1,500-foot segment.
Coverage	217.3312	X	X	At or greater than: Signal Level: 15?V Flag Alarm: No Flag or indication of invalid signal Fly-up/Fly-down Signal: 150?A Clearance and Structure in tolerance. Interference shall not cause an out-of-tolerance condition.
Monitor Reference Values	217.3313			
Angle		X	X	Within + 10.0% to -7.5% of the commissioned angle
Width		X	X	0.9? maximum. 0.5? minimum.
RF Power	217.3314	X		Not less than: Signal Level? 15?V Fly-up/Fly-down Signal: 150?A Flag Alarm: No Flag or indication of invalid signal

217.6 Adjustments. See paragraph 106.45. When equipment performance characteristics are abnormal but within tolerances, they should be discussed with maintenance personnel to determine if adjustments will increase the overall performance of the systems. Following any adjustment to correct an out-of-tolerance condition, the appropriate monitor(s) shall be checked and proper monitor operation verified.

SECTION 218. APPROACH LIGHTS

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SECTION 218. APPROACH LIGHTS

218.1 Introduction

a. An approach lighting system is a configuration of signal lights disposed symmetrically about the runway centerline extended, starting at the runway threshold and extending outward into the approach zone. This system provides visual information on runway alignment, height perception, roll guidance and horizontal references.

b. Approach lighting systems are designed to improve operational capability and safety of aircraft during approach and landing operations, particularly during the hours of darkness and/or reduced visibility. Although these facilities are considered visual navigational facilities, they are used with electronic landing aids, and generally will support reduced visibility minimums.

c. In order to meet the objective of improved safety, the approach lighting system configurations and equipment must be consistent and suited to operational requirements.

218.101 Category I Approach Lighting System, Sequenced Flashers, (ALSF-1), (Figure 218-3). This is a Category I approach lighting system with sequenced flasher lights. It consists of a light bar containing five lamps at each 100-foot interval starting 300 ft from the runway threshold and continuing out to 3,000 ft (total of 28 centerline bars). Light bars are installed perpendicular to the runway centerline extended and all lights are aimed away from the runway threshold. The centerline light bar at 1,000 ft from the threshold is supplemented with eight additional lights on either side forming a light bar 100 ft long and containing 21 lights. This bar is called the 1000-foot bar. All of the aforementioned lights are white in color. The terminating bar, installed 200 ft from the threshold, is 50 ft long and contains 11 red lights. Wing bars or pre-threshold bars, each containing 5 red lights, are located 100 ft from the threshold, one on either side of the runway. The innermost light (nearest runway centerline) of each wing is located in-line with the runway edge lights. The threshold bar is a row of green lights spaced 5 to 10 ft apart which are located near the threshold and extended across the runway threshold to approximately 45 ft from the runway edge on either side of the runway. The ALSF-1 operates on five intensity settings of 100%; 20%; 4%; 0.8%; and 0.16%. This system may be authorized for approval of Category II minima by appropriate authority.

218.102 Category II Approach Lighting System, Sequenced Flashers, (ALSF-2), (Figure 218-3). The ALSF-2 is the standard Category II approach lighting system and differs from the ALSF-1 system only in the inner 1,000 ft (nearest the runway threshold) with the outer 2,000 ft being identical for both. The terminating bar and wing bars of the ALSF-1 configuration are replaced with centerline bars of 5 white lights each. In addition, there are side row bars containing 3 red lights each on either side of the centerline bars at each light station in the inner 1,000 ft. Also, this system has an additional light bar (4 white lights each) on either side of the centerline bar 500 ft from the threshold. These lights form a crossbar referred to as the 500-foot bar. The ALSF-2 operates on five intensity settings of 100%; 20%; 4%; 0.8%; and 0.16%.

218.103 Sequenced Flashers for ALSF-1 and ALSF-2. In addition to the steady burning lights, both configurations are augmented with a system of sequenced flashing lights. One such light is installed at each centerline bar starting 1,000 ft from the threshold, out to the end of the system 3,000 ft from the threshold. Sequenced flasher lights on U.S. Air Force installations will commence 200 ft from the runway threshold. These lights sequence toward the threshold at a rate of twice per second. They appear as a ball of light traveling in the direction of the landing runway threshold at a very rapid speed.

218.104 Simplified Short Approach Lighting System (SSALS), (Figure 218-4). This is a 1400-foot system and utilizes the standard ALS centerline light bar hardware and is capable of being upgraded to a standard 3000-foot system. It consists of seven light bars of five white lamps each, spaced 200 ft apart, beginning 200 ft from the threshold. Two additional light bars, containing five white lamps each, are located on either side of the centerline bar at 1,000 ft from the runway threshold forming a crossbar 70 ft long. All lights in this system operate on three intensity settings of approximately 100%; 20%; and 4%.

218.105 Simplified Short Approach Lighting System with Sequenced Flashers (SSALF), (Figure 218-4). This system is identical to the SSALS system except for the addition of three sequenced flashers located on the runway centerline at the outer three light bar stations. These flashers assist pilots in making early identification of the system in areas of extensive ambient background light. The sequenced flashers have an "on-off" switch and will operate on all intensity settings of the steady burning lights.

218.106 Simplified Short Approach Light System with Runway Alignment Indicator Lights (SSALR), (Figure 218-4). This is a 3000-foot system and is identical to the SSALS except that five sequenced flasher lights spaced 200 ft apart are added on the centerline, beginning 200 ft beyond the end of the SSALS system. The sequenced flashers have a separate on-off switch but do not have a separate intensity control; they operate with all intensity settings of the steady burning lights and runway edge lights**.**

218.107 Medium Intensity Approach Lighting System (MALS), (Figure 218-4). This system is 1,400 ft in length, consisting of seven light bars of five lamps each, located on the runway centerline, extended and spaced 200 ft apart. Two additional light bars are located on either side of the centerline bar at 1,000 ft from the runway threshold. All lights in this system operate on two intensity settings, 100% and 10%, controlled through the runway edge lighting system.

218.108 Medium Intensity Approach Lighting System with Sequenced Flashers (MALSF), (Figure 218-4). This system is identical to the MALS except that three sequenced flasher lights are located at the outer three light bar stations. These sequenced flashers do not have an intensity control; they operate on both intensity settings of the steady burning lights.

218.109 Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR), (Figure 218-4). This system is the same as a MALS configuration except that five sequenced flashers are added on the extended runway centerline, beginning 200 ft beyond the outer end of the MALS system and extending out at 200-foot intervals to 3,000 ft. The MALSR and SSALR may have an overall length of 2,400 ft at locations where the glide slope is greater than 2.75 degrees. The MALSR may be used with precision navigation aids, i.e., PAR, ILS.

218.110 Omnidirectional Approach Lighting System (ODALS) consists of seven omnidirectional flashing lights. Five lights are located on the runway centerline extended, with the first light located 300 ft from the threshold and extending at equal intervals up to 1,500 ft from the threshold. The other two lights are located, one on each side of the runway threshold. They shall flash in sequence toward the runway threshold at a rate of once per second, with the two lights located on each side of the runway flashing simultaneously.

218.111 Runway End Identifier Lights (REIL), (Figure 218-4). The function of the REIL is to provide rapid and positive identification of the approach end of the runway. The REIL does not provide course alignment, descent or altitude information. The system consists of two synchronized flashing lights, one on each side of the landing threshold, facing the approach area. The lights flash at a rate of twice per second.

218.112 Sequence Flashing Lights (SFL)/Runway Alignment Indicator Lights (RAIL). The difference between SFL's and RAIL's is mainly one of definition. This definition is by their association with specific approach lighting systems and by their effect on visibility minimums. Inoperative SFL's for precision approach use are part of ALSF-1/2 systems. Inoperative flashers may preclude Category II/III service but do not affect Category I minimums. RAIL's are part of SSAL and MALS when used for precision approaches, and their failure results in raised Category I minimums.

218.2 Pre-Flight Requirements

218.21 Facilities Maintenance. In addition to preparations contained in Section 106.21, facilities maintenance personnel should ensure that all light units are operating, aimed at the proper angle, and in a clean condition.

218.22 Air. The flight inspector should consult with appropriate personnel to determine local operational procedures and the correct transmitter keying sequence for Radio Controlled Lights. Also see Section 106.22.

218.3 Flight Inspection Procedures

a. These lighting system configurations are identified as the United States Standard. While there are other approach lighting system configurations in existence, no attempt has been made to describe all systems in this section due to the fact that they are considered as non-standard lighting systems and will not be found in quantity. Where it is necessary to make an in-flight evaluation of non-standard systems, the flight inspector must determine that they fulfill the operational requirements for which they are installed and do not create signals which might be misleading or hazardous.

b. For airports with no prior IFR service, a night flight inspection shall be conducted to determine the adequacy of the light systems to support the procedure. Night IFR operations shall not be allowed until the night evaluation is complete.

c. Approach lights, except semi-flush lights, are aimed vertically to a point on the ILS or PAR glide path 1,600 ft in advance of the light; therefore, it is necessary that the aircraft be positioned on the glide path for proper evaluation. For non-precision type navigational facilities, a three-degree glide path angle is simulated for aiming purposes.

218.31 Checklist. The following checks will be performed on flight inspections of approach lighting systems and runway end identifier lights.

a. Light Intensity
b. Lamp Alignment
c. Inoperative Lights
d. Radio Controlled Lights.

218.32 Detailed Procedures. A commissioning flight inspection is required for all airport lighting systems, including approach lights, REILS, runway lights, and radio control of lights, that support a public-use or military instrument approach procedure. Recurring inspections will be conducted concurrently with the periodic inspection of the primary navigational facility which the lighting system supports. The periodic inspection of the primary navigational facility will be considered complete if circumstances prohibit inspection of the lighting system, provided all other checklist items have been accomplished satisfactorily.

218.321 Approach Light Systems

a. Light Intensity. The flight inspector will have the approach lighting system sequenced through the normal intensity settings to determine that the relative brightness of each intensity setting is uniform. All light units should be operating with the proper filters in place depending on the type system installed.

b. Lamp Alignment. The electronic glide slope angle will determine the proper aiming points for an Approach Lighting System. It is necessary to position the aircraft on the prescribed glide path to determine if each light and light bar is properly aimed in the system. For non-precision type instrument approaches, the lights and light bars are aimed along a theoretical glide slope angle of three degrees (3.0^0). The flight inspector will identify the lights or light bars that are inoperative or misaligned; improper aiming, up or down, can be detected by positioning the aircraft above and below the normal approach path.

c. Radio Controlled Lighting Systems. All radio controlled lighting systems associated with either a precision or non-precision Instrument Approach Procedure will be flight checked for satisfactory operation on commissioning and during subsequent periodic inspections. These light systems are activated and controlled by radio signals generated from an aircraft or a ground facility. If Pilot-Controlled Lighting is inoperative, initiate NOTAM action and attempt to contact airport authority to have the lights manually activated for night or IFR use.

Figure 218-1

RUNWAYS WITH APPROACH LIGHTS

Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
Approach Lights (Med. Int.)	2	Off	Low	Low	High
Approach Lights (Med. Int.)	3	Off	Low	Med	High
MIRL	3	Off or Low	†	†	†
HIRL	5	Off or Low	†	†	†
VASI	2	Off	◊	◊	◊

† Predetermined intensity step.
◊ Low intensity for night use. High intensity for day use as determined by photocell control.

Figure 218-2

RUNWAYS WITHOUT APPROACH LIGHTS

Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
MIRL	3	Off or Low	Low	Med	High
HIRL	5	Off or Low	Step 1 or 2	Step 3	Step 5
LIRL	1	Off	On	On	On
VASI✰	2	Off	◊	◊	◊
REIL✰	1	Off	Off	On/Off	On
REIL✰	3	Off	Low	Med	High

◊ Low intensity for night use. High intensity for day use as determined by photocell control.
✰ The control of VASI and/or REIL may be independent of other lighting systems.

218.322 Runway End Identifier Lights. The REIL lights will be checked for synchronization of the two lights and approximate flashing rate of 120 flashes per minute. NOTE: The flashing rate can be measured best by observation from the ground; however, the flight inspector should observe this feature for grossly rapid or slow flashing rate. The aiming of the REIL system will be evaluated during a visual approach, commencing from a distance of two miles from the runway threshold on the runway centerline extended. A descent will be made at a vertical angle not lower than 2.5° (530 ft @ 2 miles) to the runway threshold. The facility will be observed for blinding characteristics and overall effectiveness of the REIL system.

218.4 Flight Inspection Analysis

a. The flight inspector will observe any malfunction or noticeable defects and report such discrepancies to the persons responsible for maintenance and control of the facility. It is not intended that discrepancies found during flight inspection will result in restrictions to use of the facility unless a hazard to safety exists. For example, several lamps might be inoperative, obscured or improperly aligned, yet this condition would not have an immediate effect on overall system use. High Intensity Runway Edge Lights, Touchdown Zone, and Runway Centerline lights are required for approval of day/night Category II

Minima. When any of these systems are installed, they will be inspected in the same manner as the approach lighting system, i.e., if discrepancies are observed by the flight inspector, they should be described and reported in as much detail as possible to the operating or maintenance authority for corrective action at the earliest opportunity. The Air Traffic Control facility chief or other designated authority assigned such responsibility shall make the final decision regarding use of the Approach Lights, Runway Edge Lights, Touchdown Zone and Centerline Lights and issue appropriate Notice to Airmen.

218.5 Tolerances

218.51 Approach Lighting Systems, Runway Edge Lights, Touchdown Zone, and Runway Centerline Lights will meet the following tolerances. It is not intended that these facilities be classified in accordance with Section 107.1 unless a hazard to safety exists.

a. Light Intensity. The system shall be capable of operating on all light intensity settings; the relative intensity of all lights shall be uniform on each individual setting.

b. Lamp Alignment. All lamps shall be aimed in both vertical and horizontal axes to provide the proper guidance along an electronic glide path of approximately 3.0^{o}.

c. Inoperative Lights. For a commissioning inspection, all lights of each system must be operative, and proper filters must be in place. During routine inspection if inoperative, obscured, or misaligned lights are detected, the number and location shall be noted in as much detail as practicable and this information reported to the operating or maintenance authority for corrective action.

d. Touchdown Zone and Centerline Lighting Systems. These systems are integral parts of the Category II ILS and will conform to specified criteria. When reduced minimums have been authorized on the basis of these systems being available and operative, compliance with the below criteria is required for the application of reduced minimums. Whenever the system fails to meet the following requirements, out-of-tolerance conditions exist and the system automatically reverts to application of Category I minima.

(1) No more than 10% of the lights of the Centerline Lighting System shall be inoperative.

(2) No more than 10% of the lights on either side of the Touchdown Zone Lighting System shall be inoperative.

(3) No more than four consecutive lights of the Centerline Lighting system shall be inoperative.

(4) More than one bar (three-light fixture) of the touchdown zone system may be inoperative; however, two adjacent bars on the same side of the system shall not be inoperative. A bar is considered inoperative when all of its lights are out.

218.52 Runway End Identifier Lights (REIL) will meet the following tolerances. It is not intended that the facility be classified in accordance with Section 107.1 unless a hazard to safety exists.

a. Light Intensity. The lights shall be oriented so that the light intensity is substantially uniform on the runway centerline extended. The character of appearance of the light shall be aviation white or xenon ARC. No color is permitted, and both lights must be operative and precisely synchronized with a flash rate of 120 flashes (plus or minus 20) per minute.

b. Lamp Alignment. The system shall be aligned or shielded so as to be unobjectionable to a pilot on final approach within 1,500 ft of the runway threshold on an approach path of 2.5^{o} or higher. If the REIL lights produce an unacceptable glare within 1,500 ft of the runway threshold, the flight inspector shall request that the aiming of the lamps be adjusted.

218.6 Adjustments. Maintenance personnel should make every effort to correct any discrepancies discovered on an approach lighting system or a REIL system during the conduct of the flight inspection of the primary navigational facility. Where a hazard to safety exists, correction of discrepancies will be made prior to further use of the system; otherwise, correction of minor deficiencies will be made as soon as possible (Ref: Paragraphs 218.4 and 106.45).

Figure 218-3
LIGHTING SYSTEM CONFIGURATIONS

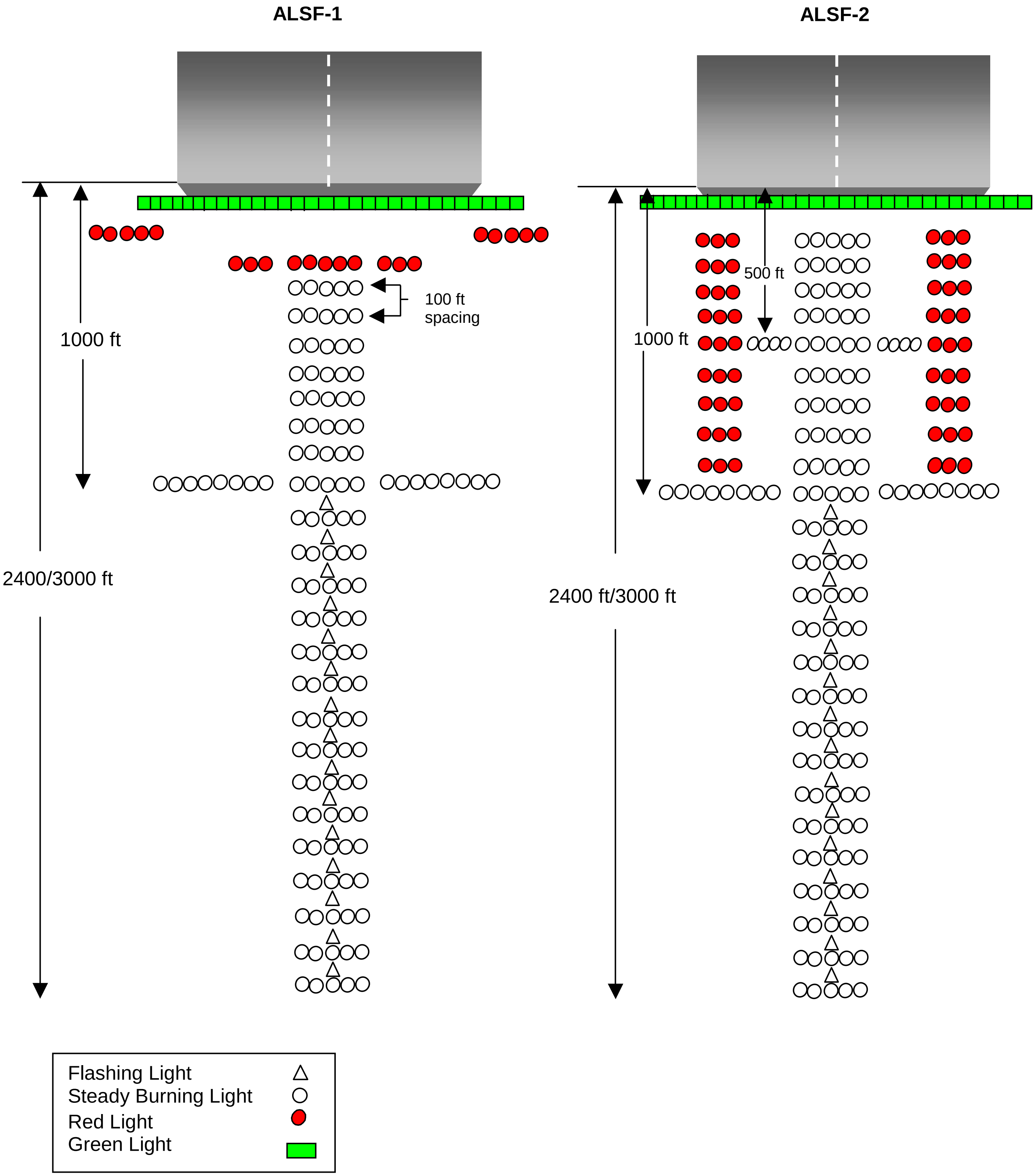
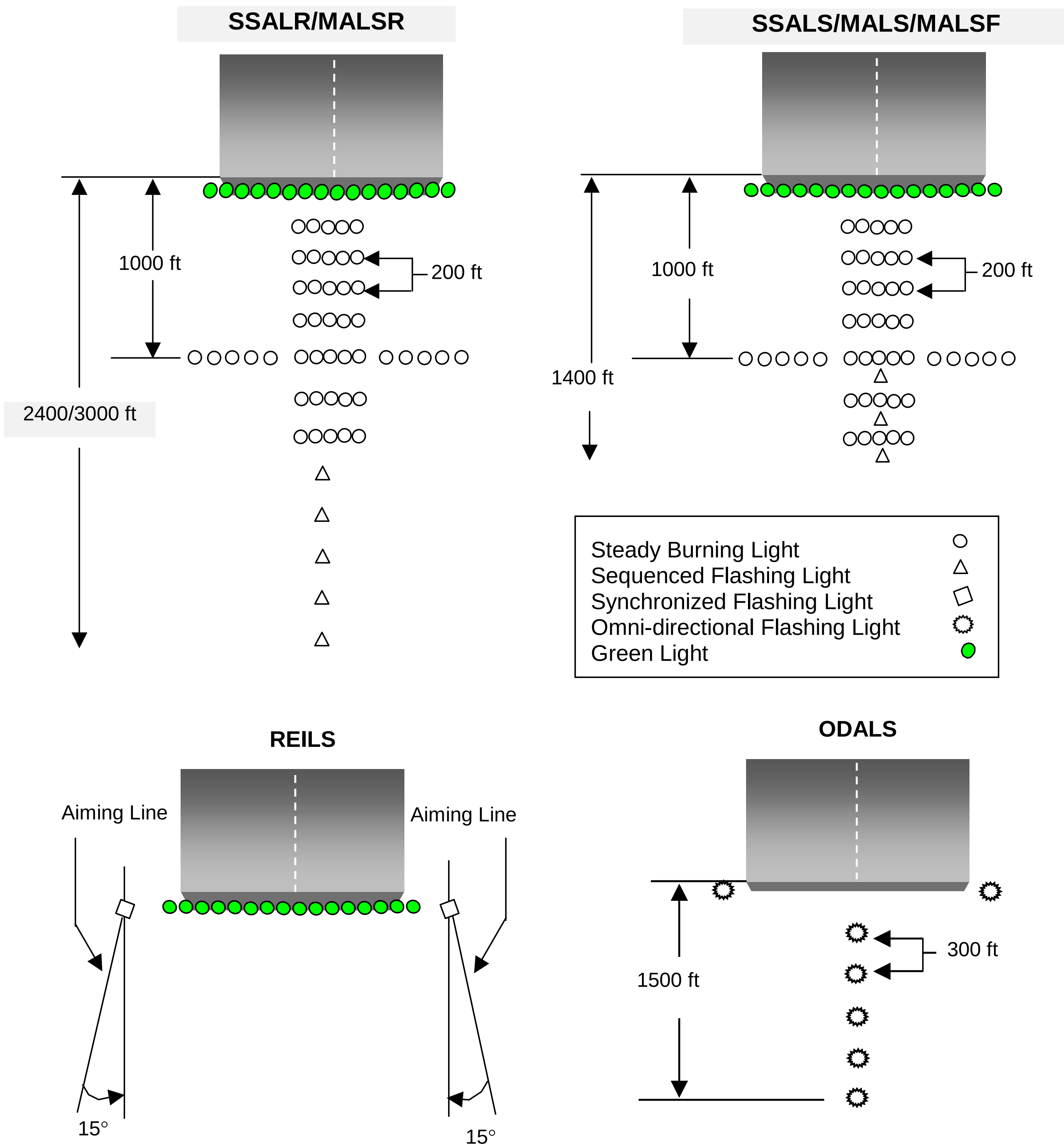


Figure 218-4
LIGHTING SYSTEM CONFIGURATIONS, continued



SECTION 219. 75 Mhz MARKER BEACON

SECTION 219. 75 MHz MARKER BEACON

219.1 Introduction.

a. This section provides instructions and performance criteria for certifying 75 megahertz (MHz) marker beacons.

b. The marker beacon is a VHF radio transmitter which propagates an elliptically-shaped (fan) vertical radiation pattern on an assigned frequency of 75 MHz. The radiation pattern is composed of a major and a minor axis. The major axis is defined as the longest diameter of the elipse while the minor axis is the shortest diameter, See Figure 219-1.

c. Functionally, marker beacons provide an aural and visual indication of station passage in association with facilities providing course guidance. Identification is provided by both a modulation frequency and a keying code.

d. Although marker beacons are basically of the same type and function, their nomenclature is generally divided into two categories: ILS markers and fan markers. The operational requirements and category are dependent upon instrument flight procedural application.

219.11 ILS Markers Description. These markers are located on the approximate instrument runway centerline extended in accordance with installation criteria specified in other documents. They are installed to indicate the position of an aircraft along the instrument approach course.

a. Outer Marker (OM).

(1) Modulation Frequency. 400 Hz, Visual Signal--Illuminates the blue lamp.

(2) Keying Code. Continuous dashes at a rate of two per second.

b. Middle Marker (MM).

(1) Modulation Frequency. 1300 Hz, Visual Signal--Illuminates the amber lamp.

(2) Keying Code. Alternating dots and dashes at a rate of 95 combinations per minute.

c. Inner Marker (IM).

(1) Modulation Frequency. 3000 Hz, Visual Signal--Illuminates the white lamp.

(2) Keying Code. Continuous dots at a rate of six dots per second.

219.12 Fan Markers (FM) Description. These markers are generally associated with nonprecision approach procedures; however, they may be associated with an ILS to serve as a localizer stepdown fix or MAP for circling approaches to secondary airports.

a. Modulation Frequency. 3000 Hz, Visual Signal--Illuminates the white lamp.

b. Keying Code.

(1) Back Course Marker. Two dot pairs at a rate of 95 pairs per minute; older equipment, 72 pairs per minute.

(2) Other Installations. Morse code letter R (• — •). Where more than one approach marker is located in the same area, different identification keying is necessary to avoid confusion. The Morse code letters K (— • —), P (• — — •),X (— • • —), and Z (— — • •) will be used in the priority listed.

219.2 Preflight Requirements. See paragraph 106.2

219.21 Facilities Maintenance Personnel. The following information shall be furnished to flight inspection prior to the commissioning check:

a. The proposed operational configuration of any adjacent marker beacon facilities which could produce interference, i.e., simultaneous operation proposed or interlock device installed.

b. Any facility alterations performed because of unique siting requirements, e.g., 8 KHz frequency separation between markers serving parallel approaches.

219.22 Flight Personnel. The calibration card shall be used to obtain the milliampere equivalent of 1,700 microvolts (*u*V) required for each modulation frequency (400 Hz, 1300 Hz, 3000 Hz); e.g., 1.8 milliampere (mA) may represent the 1700 *u*V level instead of 2.0 mA. Determine the number of light lines which represent the 1700 *u*V signal and use this reference as the minimum acceptable signal level when evaluating marker beacon coverage.

219.3 Flight Inspection Procedures.

219.31 Checklist. Markers are installed as a constituent part of some other primary aid; therefore, they are inspected concurrently with the primary aid.

ILS AND FAN MARKERS

Inspections

Type Check	Ref. Para. 219.xxx	Commissioning	Periodic	Antenna and/or transmission lines Replacement/Adjustment
Spectrum Analysis	Reserved	Reserved	Reserved	Reserved
Identification and Modulation Tone	.3202	X	X	X
Coverage	.3203			
Major axis		X	—	—
Minor axis		X	X	X
Proximity Check		X	—	—
Holding Fixes	.3205	X	—	X
Standby Equipment	.3206 106.32	X	—	—
Standby Power	.3207 106.43	X	—	—

Figure 219-1

RADIATION PATTERN - PLAN VIEW

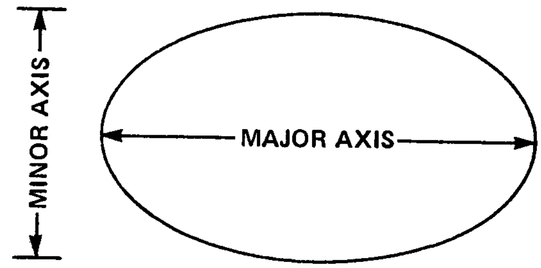
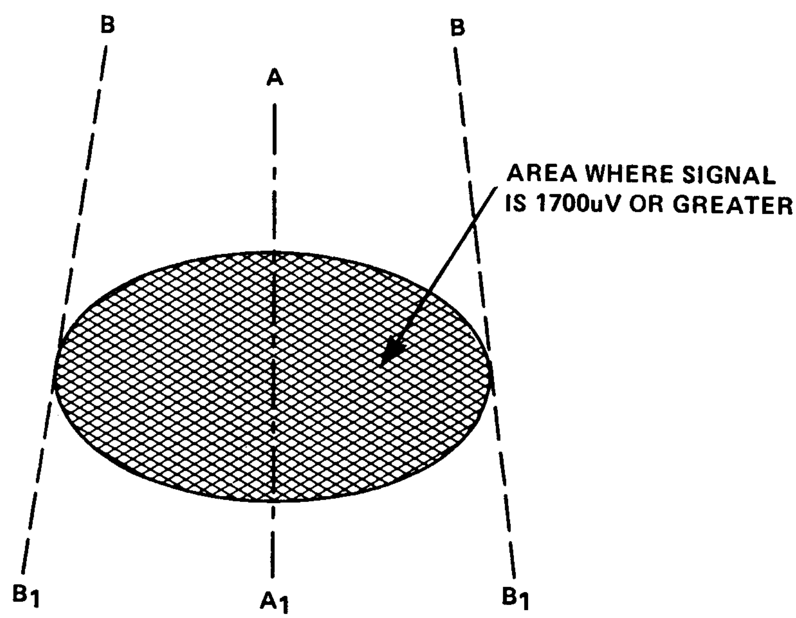


Figure 219-2

MARKER BEACON COVERAGE

A-A_1 - ELECTRONIC LOCALIZER ON-COURSE NDB OR VOR/VORTAC SIGNAL

B-B_1 - LOCALIZER/SDF/LDA 75 μA 90 or 150 Hz OR OMNI-DIRECTIONAL 5° EITHER SIDE OF THE ELECTRONIC PROCEDURAL BEARING/RADIAL



219.32 Detailed Procedures.

219.3201 Spectrum Analysis. Reserved.

219.3202 Identification and Modulation Tone. The purpose of this check is to ensure that the correct modulation tone and keying code are transmitted without interference throughout the area of required coverage Keying rate is checked by facility maintenance personnel.

Approved Procedure. Record and evaluate the keying code while flying in the radiation pattern at the proposed or published altitude(s). Check that the audio modulation tone is correct by noting that the proper light comes on for the type marker being inspected; e.g., the OM illuminates the blue lamp.

219.3203 Coverage. This check is conducted to assure that the facility will provide a radiation pattern that supports operational requirements without interfering with other facilities or instrument flight procedures. All of the commissioning coverage requirements shall be completed with any adjacent marker beacons removed from service to preclude a misrepresentative coverage analysis caused by signal intermixing. The aircraft marker beacon sensitivity shall be set at the low position for all checks.

a. Minor Axis. This check is performed to measure the actual width and quality of the radiation pattern along the procedural course where it will be used.

(1) Approved Procedure. Fly through the marker beacon signal while inbound on the electronic course providing approach guidance. Maintain the published minimum altitude to check marker beacons that support nonprecision approaches. For markers that support precision instrument flight procedures, the preferred method is to fly down the glidepath. An alternate procedure is to maintain the altitude at which the glide slope intersects the marker location. If the facility supports both precision and nonprecision procedures, and the difference between the respective intercept altitudes exceeds 100 ft, conduct the initial check at both altitudes, thereafter, either altitude may be used.

Note: Coverage will be considered satisfactory when the width is between 1,350 and 4,000 ft; 2,000 ft is the optimum width.

b. Major Axis. This measurement is conducted to verify that the marker beacon provides adequate coverage by measuring the width of the minor axis at the extremities of a pre-defined off-course sector. There is no requirement to flight inspect major axis coverage for inner markers. It is not necessary to obtain the limits of actual coverage unless requested as an engineering assist.

(1) Approved Procedure. Fly through the marker beacon signal while positioned on the course or microamp displacement which defines the required coverage limits (see Figure 219-2). Maintain the altitudes required for the minor axis measurements.

(2) Coverage Limits. The required coverage limits are predicated upon the type facility providing course guidance:

(a) Unidirectional facilities; e.g., LOC/ LDA/SDF. Coverage shall be provided 75*u*A each side of the localizer on-course signal, with the facility in normal.

(b) Omnidirectional facilities; e.g., VOR, NDB, etc. Coverage shall be provided 5^{o} each side of the on-course signal.

c. Proximity Check. These inspections supplement the basic coverage checks to assure operational compatibility between a marker beacon sited in close proximity to another marker beacon(s). The check may be performed prior to the commissioning inspection as a type of site evaluation. It shall be performed on each applicable marker beacon prior to authorizing operational use.

(1) Marker Beacon Signal Intermix. This check is conducted to determine if there is unacceptable signal derogation caused by the simultaneous operation of two or more marker beacons in close proximity.

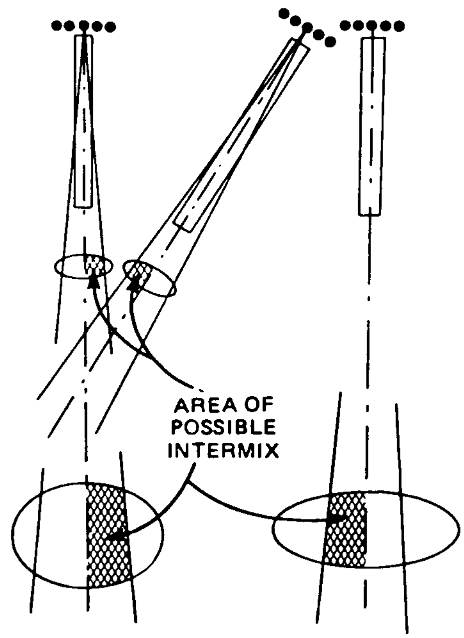
(a) Approved Procedure. Perform periodic checklist items with all marker beacons operating as proposed; in addition, check the major axis at the lowest procedural altitude on the side of the marker beacon closest to the adjacent marker. Assure that in-tolerance parameters and the following conditions are met:

1 No adverse audio interference; i.e., heterodyne.

2 Distinct fix indication that is not vague or distorted.

Figure 219-3

MARKER BEACON/PROCEDURE INTERMIX

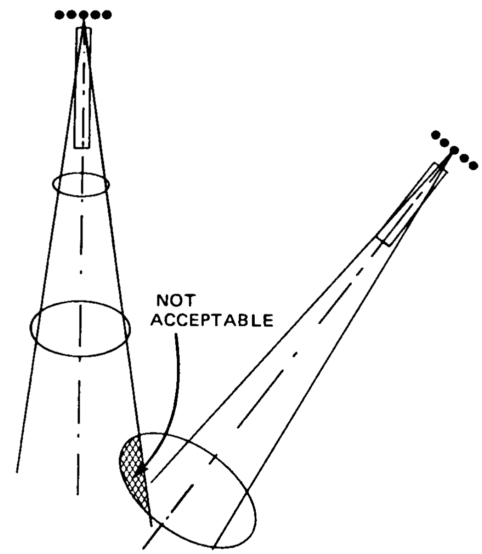


(2) Marker Beacon/Procedure Overlap. This check is conducted to assure that there are no false marker beacon indications present along an instrument approach course, which would authorize a premature descent prior to the point at which the actual fix position/marker beacon occurs. This situation could exist if the "intruding" marker beacon signal had the same modulation, even though the identifications may differ. Conduct this check only if it is suspected that this condition exists. See Figure 219-4.

(a) Approved Procedure. The flight inspector shall position the aircraft at the extremity of the approach course (150uA or 5^{o}, as appropriate) nearest the potentially misleading marker beacon at the minimum procedural altitude. If the signal intrusion into the approach area is at or above 1700uV, the procedure must be suspended until the signal intrusion can be reduced to less than 1700uV. If the signal cannot be reduced, the procedure shall be denied or the misleading marker removed from service.

Figure 219-4

MARKER BEACON OVERLAP



219.3204 Measurement Methods. Formulas appropriate to the following measurement methods are listed in Section 302.

a. Ground Speed. Using an approved unit that provides a ground speed readout, derive the average ground speed and note it on the recording. Ascertain the time required to traverse the pattern; then calculate the width using time and ground speed.

b. True Airspeed. Maintaining a constant true airspeed and altitude, traverse the marker beacon pattern on the appropriate course. A reciprocal flight shall be made in the opposite direction to eliminate the effects of wind. Calculate the width using the true airspeed and time for each crossing.

c. Known Distance. When the distance between two points on, or reasonably close to, the desired track are known (marker to runway, etc.), maintain a constant indicated airspeed and altitude throughout the segment and calculate the width by proportioning the marker distance to the known distance**.**

219.3205 Holding Fixes. Marker beacons which will be used as a fix for holding or any other instrument flight procedural use, at altitudes above those noted in paragraph 219.3203, shall be checked for major and minor axis coverage at the highest proposed altitude. If performance is not satisfactory and cannot be corrected by facility adjustment, the operational altitudes will have to be revised or procedural use denied.

219.3206 Standby Equipment. See paragraph 106.32. This equipment shall be checked in the same manner as the main equipment.

219.3207 Standby Power. Refer to paragraph 106.43; if the check is required, complete periodic checklist requirements on one set of equipment while operating on standby power.

219.4 Analysis.

a. There shall be no "holes" in the area of coverage for middle and inner markers. (See Figure 219-5.)

b. Momentary reductions in RF signal levels for outer and fan markers are acceptable, provided the reduction is 300 ft or less in duration. The reduction is considered as part of the total width. (See Figure 219-6.)

c. Figure 219-7 illustrates an out-of-tolerance condition.

Figure 219-5

TYPICAL 75 MHz MARKER WIDTH MEASUREMENT

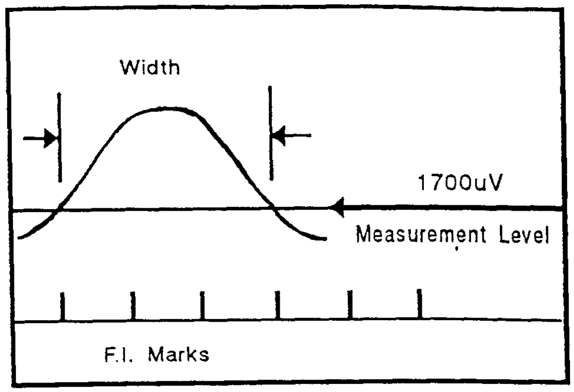


Figure 219-6

75 MHz MARKER WIDTH MEASUREMENT
A to B EQUALS WIDTH (INCLUDES THE HOLE)

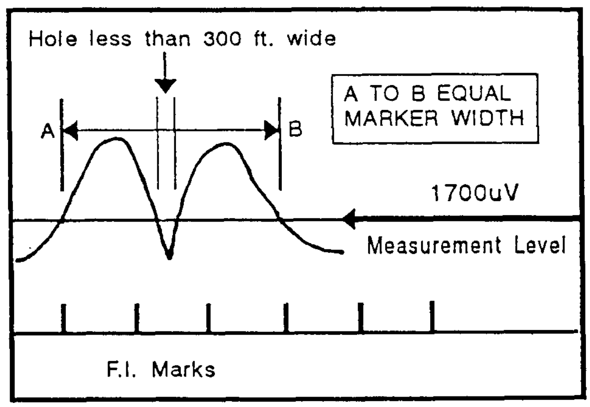
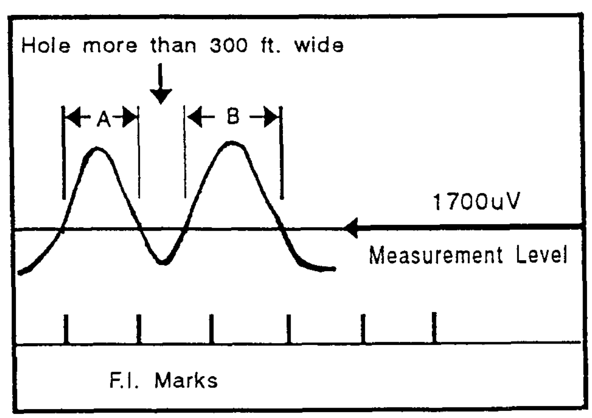


Figure 219-7

EXAMPLE OF PATTERNS NOT MEETING CRITERIA WIDTHS
A & B ARE NOT ADDITIVE



219.5 Tolerances. Marker beacons shall meet these tolerances or be removed from service. The following tolerances are applied with the receiver sensitivity in low:

Parameter	Reference Para 219.xxxx	Tolerance/Limit
Electromagnetic Spectrum	Reserved	Interference shall not cause an out-of-tolerance condition.
Identification	.3202	Distinct; correct; constant throughout the coverage area; and clearly distinguishable from any other markers.
Modulation	.3202	The modulation shall illuminate the following lights: OM - Blue Light (400 Hz) MM - Amber Light (1300 Hz) IM - White Light (3000 Hz) FM - White Light (3000 Hz)
Coverage	.3203	With a constant signal at or above 1700 microvolts (*u*V), the following widths shall be provided:
Minor Axis		
ILS Outer Marker	.3203a(1)NOTE 219.4	Width shall not be less than 1,350' or more than 4,000'
ILS Middle Marker		Width shall not be less than 675' or more than 1,325'
ILS Inner Marker		Width shall not be less than 340' or more than 660'
Fan Markers Used for a missed approach or step-down fix in the final approach segment.	219.4	Width shall not be less than 1,000' or more than 3,000'
All others		Same as ILS Outer Marker
Major Axis		
ILS Outer Marker *	.3203b(2)	Minimum: 700 Ft Maximum: 4,000 Ft Those markers installed to serve dual runways shall not exceed 4,000 ft within the normal localizer width sector of 150 *u*A either side of the procedural centerline.
ILS Middle Marker *	.3203b(2)	Minimum: 350 Ft Maximum: 1,325 Ft
ILS Inner Marker *		Not Applicable
All Others *	.3203b(2)	Any duration not to exceed the respective minor axis tolerance.
Separation		A separation between the 1700*u*V points of succeeding marker patterns which provide a fix on the same approach course; e.g., MM to IM, shall be at least 709 ft.

* As measured along the minor axis at the extremities of the pre-defined off-course sector.

SECTION 220. MICROWAVE LANDING SYSTEMS (MLS)

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SECTION 220. MICROWAVE LANDING SYSTEMS (MLS)

220.1 INTRODUCTION. This section details the flight inspection procedures and tolerances to be applied to microwave landing systems (MLS).

220.11 Coverage Ability. The MLS is capable of providing approach guidance with pilot selectable azimuth and elevation angles within the limits set by transmitted data words. Within these limits or proportional guidance, CDI deflection is proportional to aircraft deviation from the selected azimuth. Outside the proportional guidance area, the azimuth clearance guidance provides full-scale deflection. The typical service volume provides lateral coverage to 40° each side of antenna boresight, but the standard service volume may extend laterally to 60°. The elevation guidance is proportional throughout its coverage. To mitigate the effects of reflections, the limits of the antenna scan can be reduced laterally and/or vertically. Azimuth, elevation, and DME coverage is normally evaluated concurrently on all checks except some monitor checks.

220.12 Military Mobile Microwave Landing Systems (MMLS).

a. The MMLS is a tactical landing aid designed for rapid installation. MMLS may be installed in a Split-Site Configuration or, more commonly, in a collocated configuration. The Split-Site Configuration is essentially the same as any other MLS installation, requiring no special procedures other than for coverage checks. For Split-Site installations, the standard flight inspection procedures of paragraph 220.32 are used.

b. In the Collocated Configuration, the Azimuth (AZ) and DME are sited with the Elevation (EL) and provide a computed centerline approach for a normal runway or assault landing zone (ALZ). The antenna is typically 150 to 300 ft from centerline with distance from threshold dependent upon desired Minimum Glide Path (MGP). The AZ guidance is boresighted parallel with procedural centerline.

c. Procedural centerline is usually runway centerline, but unusual siting conditions may cause an offset situation. The standard flight inspection receiver will see the course as parallel to the procedural centerline and will not be guided to the runway. In the Collocated Configuration, a specialized receiver (e.g., CMLSA or multi-mode Receiver) capable of developing a "Computed Centerline," uses the AZ and DME to compute a procedural centerline based upon the facility data words. For a collocated facility providing a computed centerline, the procedures of paragraph 220.33 are used.

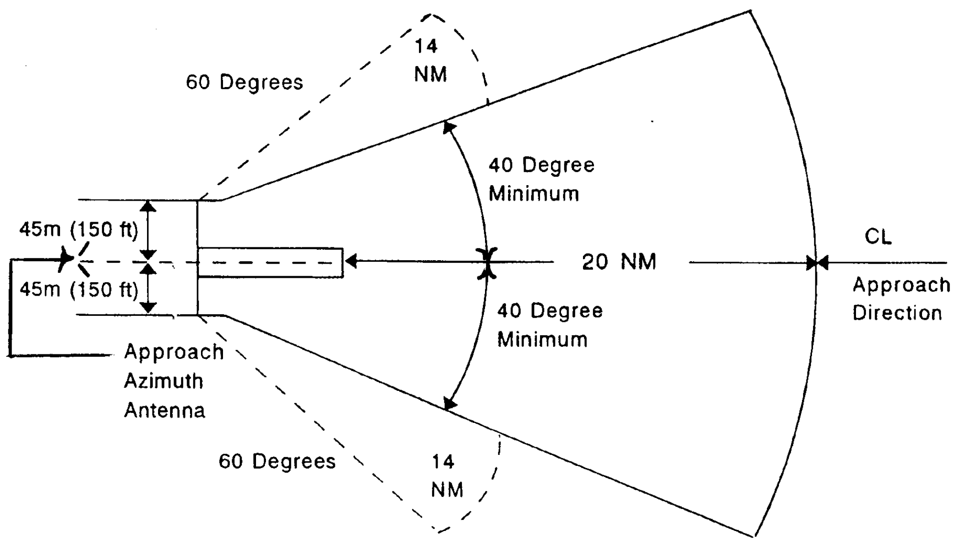
d. The MMLS does not transmit a clearance signal and will be restricted laterally if the proportional guiance limits are reduced from the normal ± 40°. MMLS facilities are designed for 15 nm Service Volume. In addition, the RF power of the MMLS is monitored but not adjustable. The 20 nm checks flown at the normal RF power will simulate the power alarm condition. All DOD MMLS facilities shall be restricted beyond 15 nm. Standard Service Volume and the coverage checks may be further reduced to 2 nm greater than the farthest procedural need; the facility shall be restricted beyond the checked distance. Most restrictions will be due to reflections or signal screening. These restrictions should be placed at the distance of occurrence. If an MMLS is confirmed to have inadequate signal strength, it shall be restricted beyond a distance equal to 0.75 times the distance of the out-of-tolerance signal.

220.13 MLS Service Volumes. The MLS standard and optional service volumes are depicted in Figures 220-1 and 2.

220.14 MLS Zones and Points. MLS Zones are depicted in Figures 220-3, 4, 5, and 6.

Figure 220-1
APPROACH AZIMUTH/DATA COVERAGE

HORIZONTAL COVERAGE



dashed lines = optional service volume

VERTICAL COVERAGE

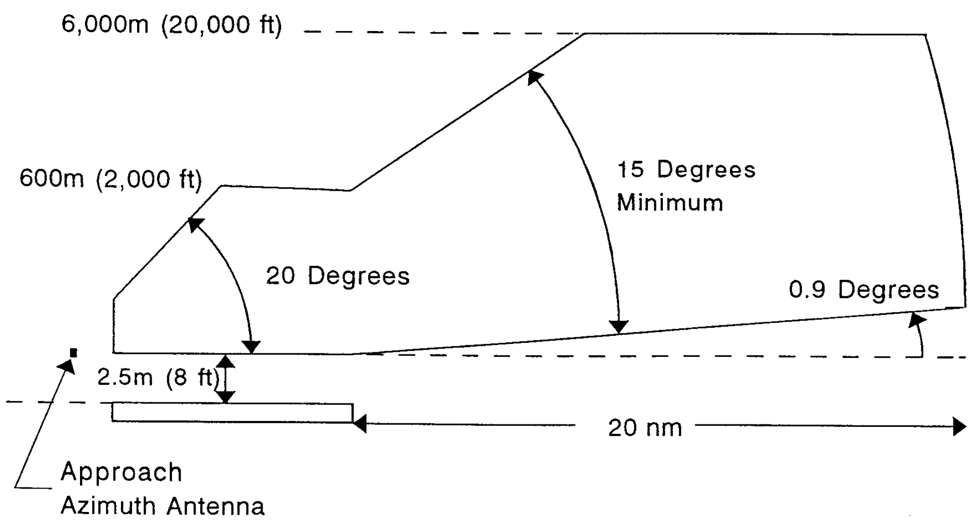
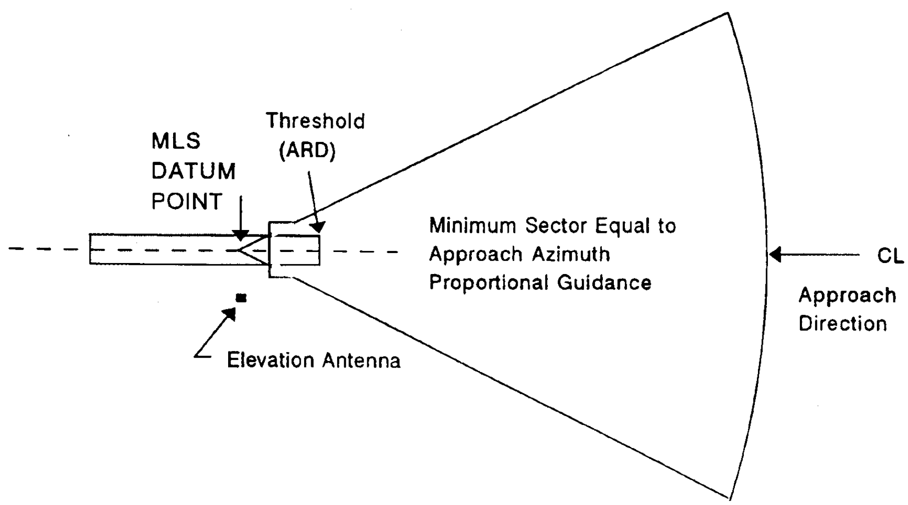


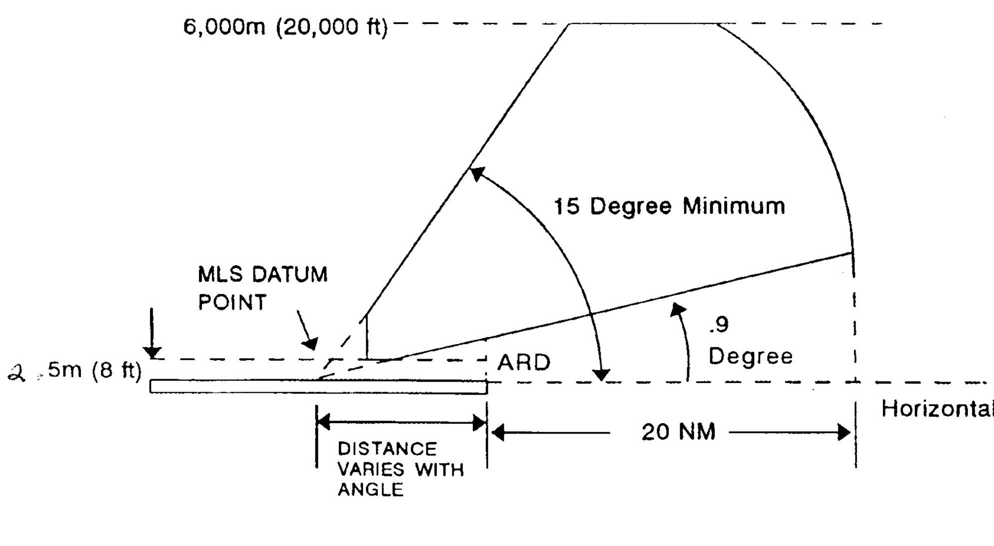
Figure 220-2

APPROACH ELEVATION COVERAGE

HORIZONTAL COVERAGE



VERTICAL COVERAGE



MLS POINTS AND ZONES

Figure 220-3

STANDARD MLS

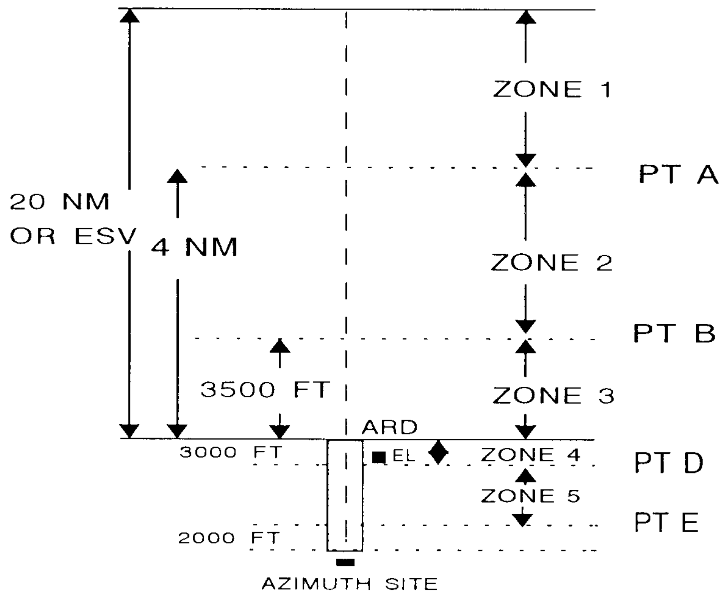
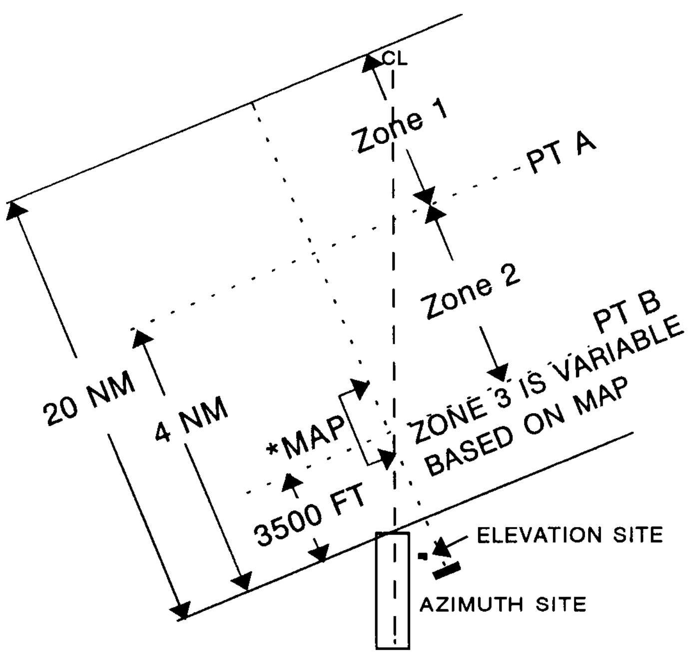


Figure 220-4

OFFSET MLS



* MAP IS VARIABLE BASED ON DECISION HEIGHT.

MLS POINTS AND ZONES, CONTINUED

Figure 220-5
COLLOCATED MLS

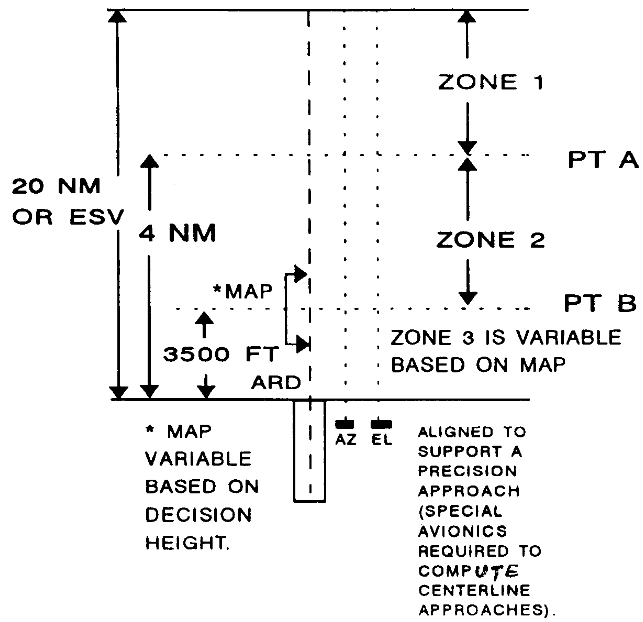
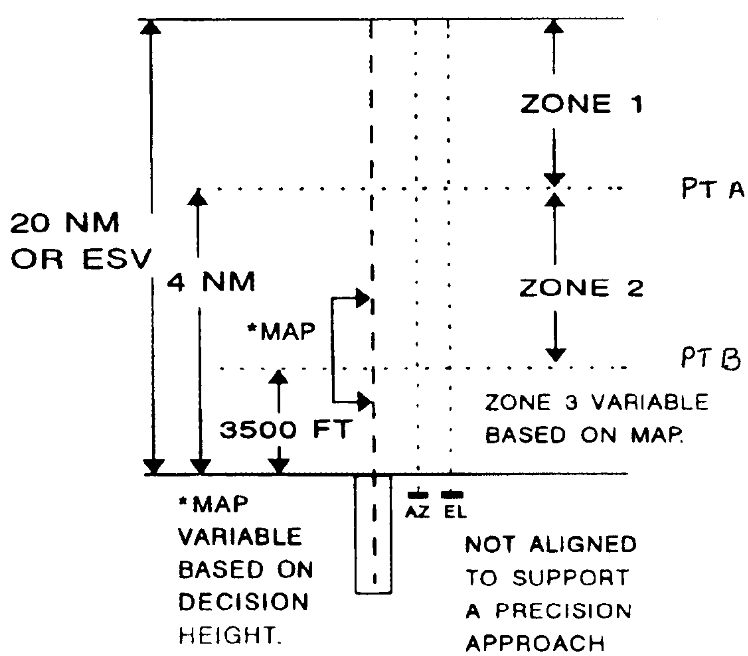


Figure 220-6
POINT IN SPACE MLS



220.2 PREFLIGHT REQUIREMENTS.

a. Review of all facility data and computation of facility error budget.

b. Review of facility horizontal and vertical terrain and obstruction profiles to determine line-of-sight characteristics and areas of possible signal anomalies. These profiles will be provided by installation engineering personnel if obstruction definition is critical to the facility performance.

220.3 FLIGHT INSPECTION PROCEDURES.

220.31 Checklists.

FIXED MLS

TYPE CHECK	REF PARA	Inspection			ANTENNA CHANGE		Measurements Required					
		C	**P**	**FC***	**AZ**	**EL**	CONFIG	**STRUCT**	**ALIGN**	**DATA**	**COVG**	**CLEAR**
Data Word Verification		X	X	X	X	X	Norm			X		
Lateral Coverage	220.3201	X			X	X	RF Power	X			X	X
Vertical Coverage	220.3202	X			X	X	RF Power	X			X	
Ref Arc	220.3201	X	X	X	X	X	Norm	X		X	X	X
Approach AZ	220.3203	X, 2	X	X	X		Norm	X	X	X		
Approach EL	220.3203	X, 2	X	X	X	X	Norm	X	X			
AZ Monitor	220.3204	X	1				Align Ref		X			
EL Monitor	220.3204	X	1				HI Angle		X		3	
		X	1				LO Angle		X			
DME	220.3207	X	X				Norm				X	
OCI Orbit	220.3205	1					Norm			X		X
Ident	220.3206	X	X				Norm				X	

NOTES:
1. Engineering or maintenance request
2. Additional Approach from Service Volume Limits at Minimum RF Power
3. Coverage below path.

* = Frequency Change

MOBILE MLS

TYPE CHECK	REF PARA	Inspection			ANTENNA CHANGE		CEU Chg 1, 2, 3	DEU Chg	Measurements Required				
		C 2	P 2	FC*	AZ	EL			CONFIG	STRUCT	ALIGN	DATA	COVG
Data Word Verification		X	X	X	X	X	X		Norm			X	
Lat Covg	220.3301	X			X	X		X, 5	Norm	X			X
Vert Covg	220.3302	X			X	X			Norm	X			X
Ref Arc	220.3201 220.3301	X	X	X	X	X			Norm	X		X	X
Approach AZ	220.3303	X,	X	X	X		X	X	Norm	X	X	X	
Approach EL	220.3303	X	X	X		X	X	X	Norm	X	X		
AZ Monitor	220.3304	X	1				X		Align Ref		X		
EL Monitor	220.3304	X X	1 1				X X		Hi Angle Lo Angle		X X		 4
DME	220.3307	X	X					X	Norm				X
Ident	220.3306	X	X				X	X	Norm				X
Computed Centerline Validation	220.3303	X							Norm		X		

NOTES:
1. Engineering or maintenance request
2. Commissioning of MMLS facilities with backup CEU's, perform "CEU Change" checklist on backup CEU. Complete Periodic requirements on both CEU's.
3. MMLS Redeployment. If the system was removed and reinstalled in its previous configuration and exact location with no changes, perform a "P" and "CEU Change" Checklist.
4. Coverage below path. Required on commissioning-type inspections.
5. 20 nm coverage arc required

*FC = Frequency Change

220.32 Detailed Procedures.

220.3201 Coverage Arcs are used to define and certify the lateral and distance limits of AZ, EL, and DME coverage. Evaluate proportional guidance and clearance coverage.

a. Service Volume Arc. A commissioning inspection maneuver to define and certify the operational range, lateral and vertical limits of the MLS service volume. Perform the inspection with the facility operating at the lowest computed power required to establish adequate signal coverage for the intended service volume.

(1) Positioning. Start the arc at the maximum usable distance and 5° outside the edge of the service volume limit. Maintain an altitude equal to the minimum glide path (MGP). If signal coverage of all MLS components cannot be maintained at the MGP, the MLS shall be restricted. There is no requirement to certify the lower, 0.9°, or higher, 20,000 ft, limits of vertical coverage unless procedurally or operationally required. The Optional Service Volume Arc should be flown at a distance of 14 nm.

(2) Inspection.

(a) Evaluate the proportional guidance service volume in 10° increments. There shall be no less than 10° proportional guidance either side of the procedural on course.

(b) While traversing the azimuth proportional guidance sectors, record azimuth and elevation deviation. Deviation crosspointer fluctuations greater than 0.5° that exceed 2° of arc, and all MLS receiver unlocks, shall be validated by radial flight, using the procedures outlined in Paragraph 220.3202 (Vertical Coverage).

b. Reference Arc. A commissioning and periodic arc throughout the proportional guidance area to assure azimuth and elevation signal coverage at the lower edge of elevation deflection sensitivity.

(1) Positioning. At a distance of between 5 and 10 nm from the ARD, start the arc 5° outside the edge of the service volume. Vertical altitude shall be computed to equal the MGP x 0.75 at the distance flown. The distance and altitude at which the arc is flown on commissioning will be recorded on the facility data sheet. This shall be the reference for periodic evaluations.

(2) Altitudes. The approximate (including earth curvature) arc altitudes above site elevation are computed below for selected angles and distance. Maintaining a centered elevation crosspointer at the correct distance will give a more precise altitude and is the preferred method of flying the arcs.

MGP ANGLE	MGP @ 20 nm	MGP x 0.75 @ 5 nm	MGP x 0.75 @ 6 nm	MGP x 0.75 @ 7 nm	MGP x 0.75 @ 8 nm	MGP x 0.75 @ 9 nm	MGP x 0.75 @ 10 nm
2.5	5659	1017	1225	1436	1648	1862	2077
2.6	5871	1056	1273	1491	1711	1933	2157
2.7	6084	1096	1321	1547	1775	2005	2237
2.8	6297	1136	1369	1603	1839	2077	2316
2.9	6509	1176	1416	1659	1903	2148	2396
3	6722	1216	1464	1714	1966	2220	2476
3.1	6935	1256	1512	1770	2030	2292	2555
3.2	7147	1295	1560	1826	2094	2363	2635
3.3	7360	1335	1608	1882	2158	2435	2715
3.4	7573	1375	1655	1937	2250	2507	2794
3.5	7786	1415	1703	1993	2285	2579	2874
4	8851	1614	1942	2272	2604	2937	3273
4.5	9917	1814	2182	2552	2923	3296	3672
5	10985	2013	2421	2831	3243	3656	4071
5.5	12054	2213	2661	3111	3562	4015	4470
6	13126	2413	2901	3391	3882	4375	4870

(3) Inspection.

(a) Evaluate the proportional guidance volume in 10° increments. There shall be no less than 10° proportional guidance either side of the procedural on course.

(b) While traversing the proportional guidance sectors, record azimuth and elevation deviation. Deviation crosspointer fluctuations greater than 0.5° that exceed 2° of arc, and all MLS receiver unlocks, shall be validated by radial flight using the procedures outlined in Paragraph 220.3202 (Vertical Coverage).

220.3202 Vertical Coverage.

a. Purpose.

(1) A commissioning maneuver to evaluate vertical coverage of the azimuth and elevation on the procedural azimuth and at ± 10° each side.

(2) Validate elevation and azimuth deviation crosspointer fluctuations noted on arcs.

b. Positioning. This check will be accomplished by a level run starting at 20 nm or ESV limits, whichever is farthest from the ARD. Start altitude shall be computed to equal the MGP x 0.75 at the FAF. Altitudes up to the MGP are acceptable outside the FAF if required to maintain signal integrity. Inside the FAF, the altitude shall be no higher than that equal to the MGP x 0.75.

c. Inspection. Record deviation, PFE, PFN, and CMN. Observe the azimuth and elevation crosspointers for excessive signal aberrations which may indicate multipath or signal shadowing. Observe the elevation crosspointer for a smooth linear transition terminating between 15 and 20°.

(1) When fluctuations exceed ± 0.5° within ±10° of the procedural on course, fly the approach offset 5° on the affected side(s) of the procedural on course and apply PFN and CMN tolerances. If the 5° offset approach is satisfactory, the approach may be placed in service.

(2) Validation of deviations noted on arcs shall be discussed with maintenance personnel for corrective action. If not correctable, the area in question shall be restricted.

(3) Increases in the minimum EL lower scan limit may present an erroneous crosspointer indication at elevation angles below the scan limit. The elevation coverage should be restricted below the adjusted lower scan limit.

(4) Increases in the minimum EL lower scan limit made after determination of normal path structure shall require a recheck of the EL approach guidance inside the FAF.

220.3203 MLS Approaches.

a. Purpose. The approach should be the first maneuver flown during a commissioning, reconfiguration, or restoration flight inspection, so that the azimuth and elevation course and coverage may be optimized to the desired procedural alignment. This maneuver is performed to verify that the azimuth and elevation facilities will satisfactorily support the proposed or published approach and categories of intended use.

b. Positioning. Approaches shall be evaluated on the designed procedural azimuth and the minimum glidepath, unless otherwise indicated. For the purpose of evaluating structure, optimizing azimuth and elevation alignments, and conducting periodic inspections, start the approach at a distance not closer than the published FAF point or 6 miles from runway threshold, whichever is greater. For commissioning, fly the approach on the MGP from the desired service volume limits at normal power and while the facility is at minimum RF power.

c. MLS Approaches Which Support Azimuth Only Minima. The final approach segment of azimuth only minima shall be checked during site evaluation, commissioning, and special inspections for azimuth antenna change and anytime there is significant deterioriation of azimuth structure. Upon reaching the FAF inbound, descend at a rate of approximately 400 ft per mile (930 ft per minute at 140 knots; 800 ft per minute at 120 knots) to an altitude of 100 ft below the lowest published MDA and maintain this altitude to the MAP.

d. Inspection.

(1) Azimuth facilities sited along runway centerline shall be evaluated through Zones 1, 2, and 3 (also Zones 4 and 5 if autoland or Cat II/III operations are authorized) on all inspections requiring alignment and structure measurements; elevation guidance on these facilities shall be evaluated to the ARD. All other facilities shall be evaluated 100 ft below DH.

NOTE: During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change inspection—check all of Zone 1.

All other inspections (i.e., periodic, periodic with monitors, etc.) evaluate structure from GSI or the FAF (whichever is further) through all other required zones.

(2) Approved RTT and/or AFIS methods shall be used for the approach evaluation. The facility error budget will provide all tolerances to be used during commissioning and periodic flight inspection. Mean course error (MCE) shall be established prior to application of PFE tolerances. Exclude data in areas that are restricted due to facility performance.

(3) For azimuth facilities sited along runway centerline IAW Figure 220-3, the azimuth MCE shall be determined and reported as found in the 1.0 nm segment ending at the ARD. For other facilities, use the 1.0 nm segment, ending at the MAP. For elevation facilities, determine the glide angle in Zone 2 as defined in Figures 220-3, 4, and 5.

(4) Visual Autoland or Category II or III Operations Authorized. On commissioning inspections, cross Point C at 100 ft, runway threshold at approximately 50 ft, and continue on the extended glidepath angle to the touchdown point. Continue the landing roll and determine the actual course alignment for Zones 4 and 5. Measure the course structure from the actual alignment. If the actual alignment for Zones 4 and 5 cannot be determined using this method, taxi the aircraft along the runway centerline from abeam the elevation site to Point E. Record the raw crosspointer information and mark, abeam the elevation site, Point D and Point E. Manually calculate the actual course alignment and structure for each of the required zones.

220.3204 Monitor References.

a. Purpose. To provide facility maintenance personnel reference readings to be used in the validation of facility monitoring parameters. Facility discrepancies shall be assigned if the alignment shift results in out-of-tolerance PFE at any distance on the approach.

b. Inspection.

(1) Azimuth monitor references shall be established after the facility is optimized to a MCE within ± 0.02° of the designed procedural azimuth. After the MCE is established, have maintenance personnel shift the system to one side, record the reference, shift the same amount to the other side, record the reference, then restore to normal. Azimuth monitors can also be established on the ground when parked within proportional guidance, maintaining line-of-sight at the maximum practical distance from the antenna. When azimuth monitors are checked on the ground, algebraically add the azimuth shift to the reported maximum PFE on the approach.

(2) Elevation monitor references are established airborne and require the MGP to be established within ± 0.02° of the commissioned angle prior to accomplishment. Request an elevation angle change of no greater than 0.10° high, record the reference, have the elevation angle changed to no greater than 0.10° low, record the reference, then restore to normal.

(3) If the elevation lower scan angle limit is increased to improve PFE, recheck normal EL path structure.

c. Below Path Coverage Evaluation. Perform this check during a commissioning flight inspection when in low angle alarm. Three runs are required, one on procedural centerline, and at 2° either side of centerline. Fly at an angle equal to [(MGP° x 0.75) - 0.25°]. Ensure that AZ/EL guidance and obstacle clearance can be maintained from the FAF to the MAP.

220.3205 Out-of-Coverage Indication (OCI). The purpose of the OCI check is to ensure that no false angle decoding occurs outside of proportional guidance coverage areas. This check is done at maintenance request if there are procedural requirements beyond the service volume. Fly an orbit radius of 6 to 10 miles about the azimuth facility for this check. The aircraft will be flown at an altitude as close to the MGP that line of site with the MLS facilities will allow. During the orbit, note the position of any decoded angles lasting longer than 4 seconds or 1.5° of arc, whichever is greater. Return to the area after completing the orbit and manually program the decoded angle into the receiver. If the angle can be locked onto and flown as a radial, even though an OCI signal is present, the problem shall be corrected, or the facility restricted. MMLS does not have OCI capability.

220.3206 Identification. The purpose of the identification check is to ensure correct identification is received throughout the coverage area. The identification can be validated by listening to the Morse code or recording basic data word 6.

220.3207 DME. The DME shall be evaluated as a DME/N throughout all areas of coverage. MLS DME is specified by ICAO to transmit the three-letter ID, dropping the preceeding M. Evaluate DME accuracy IAW Section 201. Currently commissioned facilities transmitting 4-letter on DME (e.g., M-XXX) function shall be left in service.

220.3208 Data Words. Transmitted data words containing facility siting and approach information are used by the receiver to process AZ and EL angle information, identify the station, and determine crosspointer sensitivity. Basic data words are used for all approaches. Auxiliary data words are used for RNAV or Computed Centerline Approaches. Some stations may not transmit all auxiliary data words. The AFIS, loaded with the correct facility data, is the standard for comparison with transmitted data words. If using non-AFIS equipment, the data words supplied by the facility data sheet are the standard. On commissioning, data word discrepancies shall be resolved with facility maintenance before placing the facility in service; any intentionally missing data words shall be documented on the facility data sheet.

220.33 Detailed Procedures for Collocated MMLS Providing Computed Centerline Approach. The procedures for inspecting standard MLS installations contained in 220.32 are modified as necessary to support Computed Centerline approaches. Use the procedures of paragraphs 220.32 except as directed below.

220.3301 Coverage Arcs. Arcs are flown only to measure the proportional guidance limits. The minimum limit on the equipment side of the runway is 10° beyond the published front course azimuth. On the other side, the minimum is the greater of either 10° beyond the azimuth from the MAP to the AZ antenna **OR** 5° beyond the azimuth from the threshold to the AZ antenna (see Figure 220-8). EXCEPTION: For ALZ operations where touchdown within 500 ft of threshold is essential, the non-equipment side limit may be decreased, as long as coverage is provided to at least 100 ft below Decision Height. To preclude difficulties with the vertical coverage check if the proportional guidance limit is set to the same value as the minimum required coverage, attempt to widen the proportional guidance at least an additional 2°.

220.3302 Vertical Coverage. This check will be accomplished by a level run starting at 20 nm from the antenna. The azimuth for the vertical coverage checks on the equipment side of the runway is 10° past the published front course azimuth. On the other side, fly the further of either 10° from antenna boresight azimuth or the minimum proportional guidance limit as described in Paragraph 220.3301. If the proportional guidance limits are set at the minimum required limits and cannot be expanded, it is permissible to fly the vertical coverage 2° inside of the minimum limits of proportional guidance. Document on the flight inspection report if these runs are flown inside of the standard azimuths. (See Figure 220-8.)

220.3303 Computed Centerline Approaches. Techniques for checking computed centerline procedures depend on the equipment used for the checks. Some flight inspection equipment is limited to checking only the antenna boresight signal while others can evaluate the computed centerline.

a. If the flight inspection equipment is capable of determining structure and alignment of the computed centerline and elevation signal while flying the approach course, measure these parameters on the computed centerline IAW the AFIS manual. The procedural evaluation may be accomplished using the AFIS only if the aircraft can be navigated along the computed centerline by reference to the AFIS.

b. If using theodolite or AFIS not capable of measuring the computed centerline, the azimuth boresight signal must be evaluated. When using theodolite, position the instrument to be in-line with the antenna center and use normal procedures. To inspect the azimuth boresight using AFIS, create a "pseudo runway" (see Figure 220-7). The centerline of this "runway" passes throught the AZ antenna. Runway updates are through markers on centerline at each end of the "runway". The television positioning system (TVPS) must be used unless suitable visual cues are present to accurately determine centerline and runway ends. Facility data is changed in the AFIS to use the "pseudo runway" and shall be used as the reference for AZ alignment and structure measurements. If using the pseudo runway concept, determine azimuth alignment in 1 nm segment, ending at the MAP. When using AFIS, actual, or "pseudo runway" data may be used for coverage arcs or vertical coverage checks. Coordinates of the "pseudo runway" threshold and updating method used must be documented on the commissioning report and facility data sheet.

c. Elevation. Actual runway data and normal procedures shall be used for all elevation angle and structure validation when using theodolite or AFIS with or without computed centerline capability.

d. Procedural Evaluation. On commissioning and for any change in procedural azimuth or changes in data words affecting azimuth determination, the procedure must be validated using a “computed centerline” receiver or AFIS capable of providing equivalent pilot indications. For periodic inspections including SIAP and COV checks, a standard receiver (using Pseudo Runway procedures) may be used if:

(1) Azimuth PFE is within the tolerances specified in Paragraph 220.52.

(2) Basic and Auxiliary Data Words critical to computed centerline determination match those used during final approach course certification of the current SIAP. (See Table 220-2)

220.3304 Monitors. Mobile Microwave Landing System (MMLS) AZ and EL monitor limits shall be evaluated at the actual alarm points. Optimize the AZ and EL Mean Course Errors to within 0.05° before checking monitor PFE limits. Figure 220-9 depicts the azimuths to be flown for coverage below path evaluations.

220.3305 MMLS Data Words. The MMLS data words generated by the equipment are calculated from the equipment siting and procedural information input by the installer. The equipment may use an input to generate more than one data word, and some of these words are labeled differently in the MMLS than the received words. Table 220-2 translates these words.

Table 220-2 -- DATA WORD TRANSLATOR

Word	Description	MMLS Term	AFIS Term	Least Signification Bit
Basic 1	AZ ant to Threshold Dist	DATUM/THR (5)	F DIS	100 mtr
	AZ proportional neg limit	AZ LOW LIM	F PNLM	2°
	AZ proportional pos limit	AZ UPR LIM	F PPLM	2°
	Clearance signal type	(1)	C TYPE	0=pulse/1=scan
Basic 2	Minimum glidepath angle	MIN GP	E MPA	0.1°
	Apch EL Status	FLD MON	**EL**/F/BZ	0=abnormal/1=normal
	Apch AZ Status	FLD MON	EL/**F**/BZ	0=abnormal/1=normal
	Back AZ Status	(1)(4)	EL/F/**BZ**	0=abnormal/1=normal
	DME Status	DEU/NORM/BYP	DME ST	(2)
Basic 3	AZ Beamwidth	(1)	F BMW	0.5°
	EL Beamwidth	(1)	E BMW	0.5°
	DME Distance	AZ/DATUM DIST	DDIS	12.5 mtr
Basic 4	AZ Mag Orientation	AZ MAG ORIENT	F ALN	1° (3)(6)
	Back AZ Orientation	(4)	B ALN	1°
Basic 5	Back AZ neg prop limit	(4)	B PNLM	2°
	Back AZ pos prop limit	(4)	B PPLM	2°
	Back AZ Beamwidth	(4)	B BMW	0.5°
Basic 6	MLS Identification	3-letter entry	FAC ID	
AUX 1	AZ antenna offset	AZ OFFSET DIST	F OFF	1 mtr (8)(6)
	AZ antenna to Datum Point distance	AZ/DATUM DIST	F DIS	1 mtr (6)
	AZ alignment with Rwy C/L	AZ W/CL	F ALN	0.01° (8)(6)
	AZ coordinate system	(1)	AZ C/P	0=Conical/1=planar
	AZ antenna phase center height	AZ ANT HGT	AZ HT	1 mtr
AUX 2	EL antenna offset	EL OFFSET DIST	E OFF	1 mtr (8)
	Datum point to threshold distance	DATUM/THR	MLS DIS	1 mtr (6)
	EL antenna phase center height	EL ANT HGT	E HT	0.1 mtr
	Datum point elevation	DATUM ELEV	MLS HT	1 mtr (9)
	Threshold Height	THRESH HGT	RWY HT	0.1 mtr
AUX 3	DME offset	AZ OFFSET DIST	DME OFF	1 mtr (8)(6)
	DME to datum point distance	AZ/DATUM DIST	DME DIS	1 mtr (6)
	DME antenna height	AZ ANT HGT	DME HT	1 mtr
	RWY stop end distance	STOP END DIS	RWY SND	1 mtr (9)
AUX 4	Back AZ ant offset	(4)	B OFF	1 mtr (8)
	Back AZ to datum point distance	(4)	B DIS	1 mtr
	Back AZ align with rwy C/L	(4)	B ALN	0.01° (8)
	Back AZ coord sys	(4)	BZ C/P	0=Conical/1=Planar
	Back AZ ant phase center height	(4)	B HT	1 mtr

Notes:

1. Factory set, no field input

2. DME status codes:
- 0 0 DME inoperative or not available
- 0 1 Only initial approach or DME/N available (normal MMLS status)
- 1 0 Final approach mode std 1 available
- 1 1 Final approach mode std 2 available

3. Magnetic orientation is 180° from procedural front course azimuth.

4. Back azimuth not used.

5. Split-site configuration is combined value: AZ/DATUM DIST DATUM/THR

6. Computed centerline critical values

7. Distances and heights are with respect to MLS datum point.

8. Negative number indicates left of C/L looking from threshold to stop end.

9. May be zero or actual value.

220.3306 ID. To preclude confusion with DME indications, ensure the MMLS identification is not the same as any other DME source used for any approach or missed approach guidance.

220.3307 DME. When the MMLS is placed in an abnormal configuration for monitor checks or adjustments, the DME continues transmitting, but the pulse spacing is changed to 33 microseconds. With the normal “Y” channel DME spacing of 30 microseconds, some receivers may remain locked onto the DME signal. This indication is not hazardous and should be disregarded.

220.4 ANALYSIS.

a. Azimuth PFE, PFN, and CMN will be evaluated over any 40-second interval of radial flight within the coverage area. Measured parameters shall be in tolerance for no less than 95 percent of the interval measured. PFE tolerances shall only be applied with use of AFIS or RTT.

b. Elevation PFE, PFN, and CMN will be evaluated over any 10-second interval of radial flight within the coverage area when on a selected glide path at or above the MGP. Measured parameters shall be in tolerance for no less than 95 percent of the interval measured. PFE tolerances shall only be applied with use of AFIS or RTT when flown radially.

c. Manual analysis of PFN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration greater than:

(1) 6.3 seconds for azimuth

(2) 2 seconds for elevation

d. Manual analysis of CMN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration less than:

(1) 10.4 seconds for azimuth

(2) 6.3 seconds for elevation

(3) CMN filter bandpass frequency overlaps a portion of the PFE bandpass frequency. The resultant CMN signal will be superimposed upon the PFE component, resulting in a larger error than is actually present. CMN shall be reported after subtraction of the PFE component.

e. Monitor limits are determined by the maximum PFE found in the alarm configurations. If monitors are checked airborne, make separate runs,measuring PFE in each configuration. If the AZ alignment monitor is checked on the ground, algebraically add the amount of alignment change to the PFE value found on the normal approach.

220.5 TOLERANCES.

220.51 Facility Error Budgets. Due to the unique siting requirements of each MLS installation and the resulting difference in tolerances, a MLS error budget shall be computed for each facility. The location of the azimuth site determines the Reference Point to be used in the computation of the error budget. The EL error budget reference point shall coincide with the AZ.

a. ARD when the azimuth is sited along or within 1.00° of runway centerline. (See Figure 220-3).

b. MAP when the azimuth is:

(1) Offset. (See Figure 220-4).

NOTE: Azimuth antennas installed with a distance to Missed Approach Point/Decision Height greater than 9,115 ft shall have a tolerance of 0.11° for PFN and 0.22° for PFE applied at the MAP.

(2) Co-located azimuth with elevation. (See Figure 220-5).

(3) Heliports which are considered to be those facilities with less than 2,300 ft between the azimuth and the approach reference datum when sited along runway centerline.

(4) Non-precision approach aid terminating at a point in space and not aligned with a precision runway. (See Figure 220-6.)

220.511 Application of Tolerance Degradation Factors. Tolerances are specified as the calculated or standard value at the reference point, either ARD or MAP. These tolerances may be widened (in most cases to an indicated maximum value) by the indicated degradation factors with increasing distance, lateral, or elevation displacement from the reference point. To calculate azimuth tolerance at a given point, use the following steps, in order:

a. Determine the tolerance at the reference point, using the formula in paragraph 302.10.

b. Define the measurement point in distance, lateral angle, and elevation angle from the reference point

c. C/L Distance Degraded Tolerance

(1) Multiply the tolerance at the reference point by the distance degradation factor. This gives the maximum boresight tolerance at 20 nm.

(2) Subtract the tolerance at the reference point from the tolerance at 20 nm. This gives the Maximum Degradation.

(3) Divide the maximum degradation by 20, giving the degradation increment (degrees per nm).

(4) Multiply the degradation increment by the mileage from ARD of the measurement point, then add the original tolerance at the reference point. The result is the tolerance on C/L (boresight) at the distance of the measurement point.

d. Laterally Degraded Tolerance

(1) Multiply the distance degraded tolerance from Step c(4) above by the off-course degradation factor, giving the maximum degradation at 40 (60)° at the specified distance.

(2) Subtract the C/L value from the value at 40°. The result is the maximum degradation.

(3) Divide the maximum degradation by 40 to get the degradation Increment (degrees per degree).

(4) Multiply the Degradation Increment by the number of degrees off-course at the measurement point; add this value to the value from Step c(4) above. This gives the tolerance at the measurement distance and lateral offset.

e. Vertically Degraded Tolerance (above 9° only).

(1) Multiply the distance and laterally degraded tolerance from Step d(4) above by the vertical degradation factor, giving the maximum tolerance at 15° elevation at the specified distance and lateral offset.

(2) Subtract the distance and laterally degraded value (Step d(4)). The result is the maximum degradation.

(3) Divide the maximum degradation by the number of degrees difference from the MGP and 15° to get the degradation increment (degrees per degree).

(4) Multiple the degradation increment by the number of degrees above the MGP at the measurement point; add this value to the value from d(4). This gives the tolerance degraded by all three factors.

f. The tolerance to be applied is the greater of either the value calculated above, or the maximum, as listed in the individual facilities listed below.

EXAMPLE:

Given: AZ to ARD distance – 7,965 ft, MGP – 3.0°
PFE tolerance at ARD from 220.5a(1) – 20 ft

Find: AZ PFE tolerance at 14 nm from ARD, @ 10° off-course, @ 12°

220.511 step	Calculation	Result	Definition
a	Arctan (20 / 7,965)	0.1438	Tolerance at ARD
c(1)	(0.1438 x 1.2)	0.1726	Tolerance @ 20 nm on C/L @ 3.00°
c(2)	(0.1726 – 0.1438)	0.0288	Maximum Degradation
c(3)	(0.0288 / 20 nm)	0.0014 per nm	Degradation Increment
c(4)	(0.0014 x 14 nm) + 0.1438	0.01634	Tolerance @ 14 nm on C/L @ 3.00°
d(1)	(0.1634 x 1.5)	0.2451	Tolerance @ 14 nm @ 40°
d(2)	(0.2451 – 0.1634)	0.0817	Maximum Degradation
d(3)	(0.0817 / 40°)	0.0020 per degree	Degradation Increment
d(4)	(0.0020 x 10°) + 0.1634	0.1834	Tolerance @ 14 nm @ 10° @ 3.00°
e(1)	(0.1834 x 1.5)	0.2751	Tolerance @ 14 nm @ 10° @ 15°
e(2)	(0.2751 – 0.1834)	0.0917	Maximum Degradation
e(3)	(0.0917 / 12°)	0.0076	Degradation Increment
e(4)	(0.0076 x 9°) + 0.1834	0.2518	Tolerance @ 14nm @ 10° @ 12°

220.512 Standby Equipment shall meet the same tolerances as the primary equipment.

220.513 Alignment shall be reported as the average flight inspection angle. Facilities found with an alignment that exceeds 60% of the allowable PFE shall generate a maintenance alert IAW Para 217.45b. Facilities shall not be NOTAMed unless the PFE allowance at the reference point is exceeded.

220.52 Individual System Tolerances

a. Standard Facilities.

(1) Centerline Azimuth Facilities (see Figure 220-5)

Parameter	Ref. Para	Inspection C	Inspection P	Tolerance/Limit at ARD	Maximums	Degradation Factors
Alignment (MCE)	220.3203	X X	**X**	0.02 0.05 Military non-autoland only **PFE tolerances apply**		
PFE	220.4c	X	X	20 ft not to exceed 0.25°	<9° EL=0.25° >9° EL=0.50°	(1)
PFN	220.4c	X	X	11.5 ft not to exceed 0.25°	<9° EL=0.25° >9° EL=0.50°	(1)
CMN (Autoland Authorized)	220.4d	X	X	10.5 ft not to exceed 0.10° within 10° from C/L More than 10° from C/L = .20	0.10°	(2)
Runway Area (Autoland Authorized)	220.4	X	X	Zones 4 and 5 PFE/PFN/CMN tolerances are equal to the linear (footage) values at the ARD.		
CMN (Cat I Minima)	220.4	X	X	0.10° within 10° of rwy C/L 0.20° beyond 10° from rwy C/L	0.10° 0.20°	
Alignment Monitor	220.3204	X	X	PFE tolerances apply		

(1) On C/L at 20 nm = 1.2 x ARD value
At 40° off course = 1.5 x C/L value at same distance from ARD.
At 60° off course = 2.0 x C/L value at same distance from ARD.
From +9 to +15° EL = 1.5x value at same distance and direction

(2) Linear increase to 0.10° at 20 nm

(2) Offset Azimuth, Azimuth Collocated with Elevation, and Heliport Azimuth Facilities

Parameter	Ref. Para	Inspection C	Inspection P	Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
Alignment (MCE)	220.3203	X	X	0.02° PFE tolerances apply		
PFE	220.4c	X	X	28 ft not to exceed 0.50	0.50°	(1)
PFN	220.4c	X	X	14 ft not to exceed 0.50	0.50°	(1)
CMN	220.4d	X	X	0.20°	0.20°	
Alignment Monitor	220.3204	X	X	PFE tolerances apply		

(1) On procedural C/L at 20 nm=1.2 x Reference Point value
At 40° off course = 1.5 x procedural C/L value at same distance from Reference Point
From +9 to +15° EL = 1.5 x value at same distance and direction from Reference Point

(3) Azimuth and Elevation Facilities Not Aligned as a Precision Approach Aid to a Runway

Parameter	Ref. Para	Inspection		Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
		C	P			
Alignment (MCE)	220.3203d	X	X	(1)		
PFE	220.4c			No requirements		
PFN	220.4c	X	X	0.50°		None
CMN	220.4d	X	X	0.20°		None

(1) Alignment shall be considered satisfactory when the flight inspector determines that the azimuth on course and elevation rate of descent allow safe completion of the procedure as published.

(4) Elevation

Parameter	Ref. Para	Inspection		Tolerance/Limit @ 3.0° @ Reference Point	Maximums	Degradation Factors
		C	P			
Alignment (MCE)	220.3203d	X	X	0.02° PFE tolerances apply		
PFE	220.4c	X	X	0.133		(1) (2) (5)
PFN	220.4c	X	X	0.087		(1) (2) (5)
CMN (autoland authorized)	220.4d	X	X	0.05	Within 10° of rwy C/L = 0.10° Beyond 10° of rwy C/L = 0.20°	(3) (4)
CMN (Cat I minima)	220.4d	X	X	0.10	Within 10° of rwy C/L = 0.10° Beyond 10° of rwy C/L = 0.20°	
Alignment Monitor	220.3204	X	X		PFE tolerances apply	

(1) On C/L at 20 nm = 1.2 x ARD value
(2) At 40° off course = 1.2 x C/L value at same distance from Reference Point
At +15° EL = 2.0 x value at same distance and direction from Reference Point
(3) Linear increase to 0.10° at 20 nm
(4) At 40° off course = 2.0 x C/L value at same distance from Reference Point
(5) With decreasing elevation angle: The PFE and PFN limits from +3° (or 60% of the MGP, whichever is less) to the coverage extreme, are degraded linearly by a factor of 3 times the value at the Reference Point.

b. MMLS Facilities Authorized for no Lower than Category I Minima Use by U.S. Military Aircraft Only

(1) Splite-Site Centerline Azimuth

Parameter	Ref. Para	Inspection		Tolerance/Limit at ARD	Maximums	Degradation Factors
		C	P			
Alignment (MCE)	220.3203	X	X	0.05° PFE tolerances apply		
PFE	220.4c	X	X	28 ft not to exceed 0.50°	0.50°	(1)
PFN	220.4c	X	X	14 ft not to exceed 0.50°	0.50°	(1)
CMN	220.4d	X	X	0.20°		
Alignment Monitor	220.3204	X	X	PFE tolerances apply		

(1) On C/L at 20 nm = 1.2 x MAP value

(2) Azimuth Collocated with Elevation

Parameter	Ref. Para 220.xx	Inspection		Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
		C	P			
Alignment (MCE)	.3203 .3303	X	 X	0.05° PFE tolerances apply		
PFE	.4c	X	X	35 ft not to exceed 0.50°	0.50°	(1) (2)
PFN	.4c	X	X	66% of allowable PFE	0.50°	(1) (2)
CMN	.4d	X	X	0.20°	0.20°	None
Alignment Monitor	.3304	X	X	PFE tolerances apply		

(1) On C/L at 20 nm = 1.2 x Reference Point value
(2) At 40° off course = 1.5 x C/L value at same distance from Reference Point

(3) Elevation

Parameter	Ref. Para 220.xx	Inspection		Tolerance/Limit @ Reference Point	Maximums	Degradation Factors
		C	P			
Alignment (MCE)	.3203 .3303	X	 X	0.05° PFE tolerances apply		
PFE	.4c	X	X	0.20°	0.20°	None
PFN	.4c	X	X	0.133°	0.133°	None
CMN	.4d	X	X	0.20°	0.20°	None
Alignment Monitor	.3304	X	X	PFE tolerances apply		

220.53 Data Words. The AFIS is the reference for the correctness of the received data words (data sheet for non-AFIS). Due to calculation rounding and feet/meter conversion, some apparent errors occur. When the received data words do not match the AFIS expected values, the differences must be resolved with facility maintenance. The transmitted data words from the MMLS facility shall be correct. The following data words, if transmitted, have acceptable tolerances; all other values must match.

a. Basic Data Words

Word	Description	Tolerance
Basic 1	AZ to threshold distance	± 1 Meter
Basic 3	DME distance	± 1 Meter

b. Auxiliary Data Words

Word	Description	Tolerance
AUX 1	Az to Offset	± 1 Meter
	Az to MDPT	± 1 Meter
	Az Ant Height	± 1 Meter
AUX 2	El Ant Offset	± 1 Meter
	MDPT Distance	± 1 Meter
	El Ant Height	± 0.1 Meter
	MDPT Height	± 1 Meter
	Threshold Height	± 0.1 Meter
AUX 3	DME Offset	± 1 Meter
	DME to MDPT Distance	± 1 Meter
	DME Ant Height	± 1 Meter
	Rwy Stop End Distance	± 1 Meter

Figure 220-7
PSEUDO RUNWAY

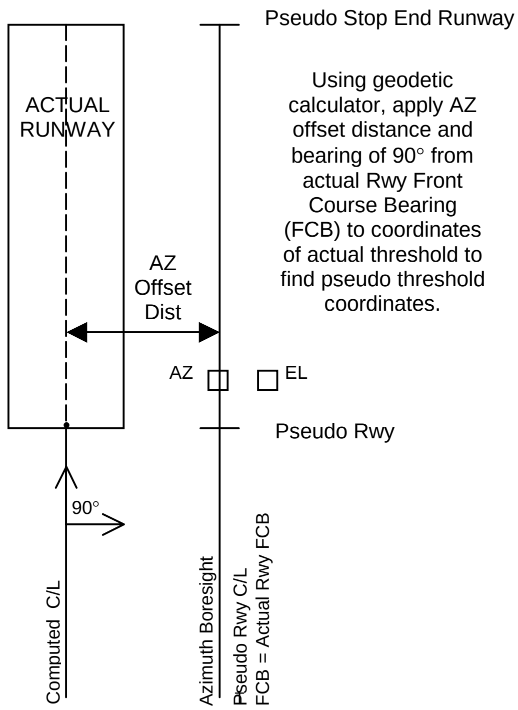
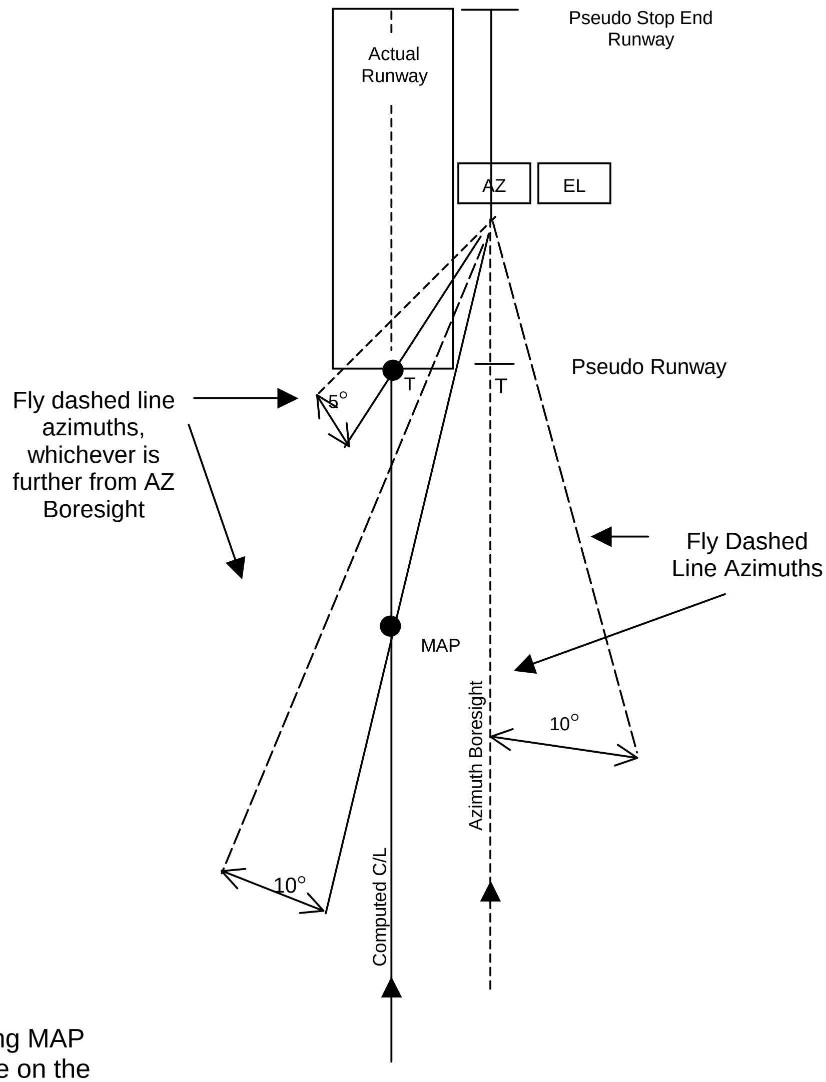


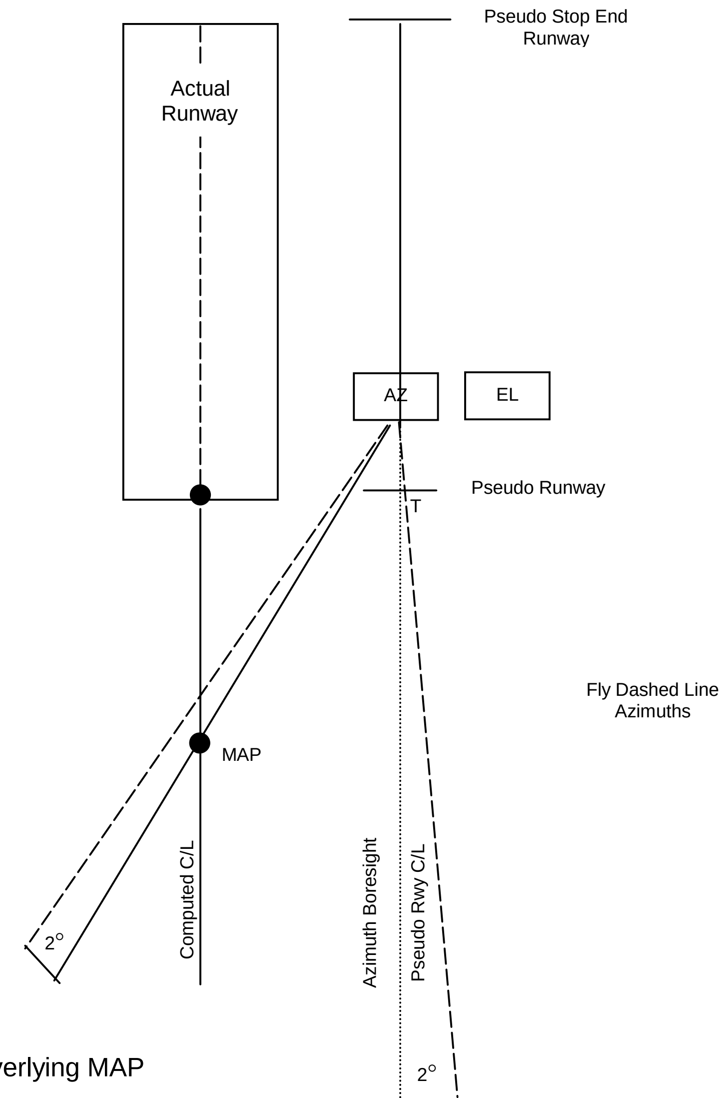
Figure 220-8
MMLS COVERAGE VALIDATION AND MINIMUM PROPORTIONAL GUIDANCE



Bearings overlying MAP and threshold are on the Facility Data Sheet

Figure 220-9

AZIMUTHS FOR COVERAGE BELOW PATH (COMPUTED CENTERLINE FACILITIES)



Bearings overlying MAP are on the Facility Data Sheet

SECTIONS 221 - 299

RESERVED

CHAPTER 300. SUPPLEMENTAL INFORMATION

SECTION 301. GLOSSARY OF ABBREVIATIONS, ACRONYMS, DEFINITIONS, AND SYMBOLS

301.1 Definitions and Symbols. The use of italics within a definition denotes another definition contained within this section.

Actual Glidepath Alignment or Actual Glidepath Angle. The straight line arithmetic mean of all deviations around the *on-path* position derived in ILS zone 2.

Actual Course (Alignment). The straight line arithmetic mean of all deviations around the *on-course* position derived from the area in which alignment was taken.

Actual Navigation Performance (ANP). Sometimes called Estimated Position Error (EPE) or "Q" factor, is an onboard computation of the estimated 95% Navigation System Error using knowledge of the real world navigation environment, i.e., number of satellites tracked, number/geometry of ground facilities, and statistical error models of the various navigation sources. ANP is continuously compared to RNP, and the crew is alerted if ANP exceeds RNP.

AFIS Corrected Error Trace. A graphical presentation of deviation about the mean of all points measured in ILS Zone 2 for glidepaths and zones 2 and 3 for localizers.

Automatic Gain Control (AGC). A process of electronically regulating the gain in the amplification stages of a receiver so that the output signal tends to remain constant though the incoming signal may vary in strength.

AGC Current or Voltage. A current or voltage responding to the action of the AGC circuit that may be interpreted in terms of signal intensity.

Air Traffic Control Radar Beacon System (ATCRBS). The general term of the ultimate in functional capability afforded by several automation systems. Each differs in functional capabilities and equipment. ARTS IA, ARTS II, ARTS III, and ARTS IIIA (see AIM).

Airway/Federal Airway. A control area or portion thereof established in the form of a corridor, the centerline of which is defined by navigational aids (refer to FAR Part 71, AIM).

Alignment. Coincidence of a positional or directional element with its nominal reference.

Alignment, Azimuth. The azimuth or actual magnetic bearing of a course.

Alignment, Elevation. The actual angle above a horizontal plan originating at a specific point of a course used for altitude guidance.

Alignment Error. The angular or linear displacement of a positional or directional element from its normal reference.

Alignment Error, Azimuth. The difference in degrees between the position of a selected course and the correct magnetic azimuth for this course.

Note: The error is positive when the course is clockwise from the correct azimuth.

Alignment Error, Elevation. The difference in degrees between the measured angle of the course and the correct angle for the course.

Note: The error is positive when the course is above the correct angle.

ALTITUDES:

a. Absolute Altitude. The altitude of the aircraft above the surface it is flying (AC 00-6A). It may be read on a radio/radar altimeter.

b. Calibrated Altitude. Indicated altitude corrected for static pressure error, installation error, and instrument error.

c. Indicated Altitude. The altitude as shown by an altimeter on a pressure or barometric altimeter. It is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions (AIM).

d. Pressure Altitude. Altitude read on the altimeter when the instrument is adjusted to indicate height above the standard datum plane (29.92" Hg.)(AC 61-27 latest revision).

e. True Altitude. The calibrated altitude corrected for nonstandard atmospheric conditions. It is the actual height above mean sea level (AC 61-27 and AFM 51-37).

Ampere. A unit of electric current such as would be given with an electromotive force of one volt through a wire having a resistance of one OHM. See Symbols. See Crosspointer.

Amplitude (Peak). The maximum instantaneous value of a varying voltage or current measured as either a positive or negative value.

Anomalous Propagation. Weather phenomena resulting in a layer in the atmosphere capable of reflecting or refracting electromagnetic waves either toward or away from the surface of the earth.

Angle Voltage. The alignment points of the azimuth and elevation electronic cursors are expressed in angle voltage or dial divisions.

Antenna. A device used to radiate or receive electromagnetic signals.

Antenna Reflector. That portion of a directional array, frequently indirectly excited, which reduces the field intensity behind the array and increases it in the forward direction.

Approach Azimuth. Equipment which provides lateral guidance to aircraft in the approach and runway regions. This equipment may radiate the Approach Azimuth function or the High Rate Approach Azimuth function along with appropriate basic and auxiliary data.

Approach Elevation. The equipment which provides vertical guidance in the approach region. This equipment radiates the Approach Elevation function.

Approach Reference Datum (ARD). A point at a specified height located vertically above the intersection of the runway centerline and the threshold.

Area Navigation (RNAV). A method of navigation that permits aircraft operations on any desired course within the coverage of station referenced navigation signals or within the limits of self-contained system capability (AIM).

Area VOT. A facility designed for use on the ground or in the air. It may be located to provide the test signal to one or more airports.

Attenuation. The reduction in the strength of a signal, expressed in decibels (dB).

Average Course Signal. The course determined by drawing the mean of the maximum course deviations due to roughness and scalloping.

Azimuth. A direction at a reference point expressed as the angle in the horizontal plane between a reference line and the line joining the reference point to another point, usually measured clockwise from the reference line.

Auxiliary Data. Data, transmitted in addition to basic data, that provide facilities maintenance equipment siting information for use in refining airborne position calculations and other supplementary information.

Barometric Vertical Navigation (BARO VNAV). A navigation system which presents computed vertical guidance to the pilot. The computer-resolved Glidepath Angle (GPA) is based on barometric altitude, and is either computed as a geometric angle between two waypoints, or an angle from a single waypoint.

Baseline Extension (Loran-C). The extension of the baseline beyond the master or secondary station. Navigation in this region may be inaccurate due to geometrical considerations resulting in ambiguous position solutions.

Basic Data. Data transmitted by the facilities maintenance equipment that are associated directly with the operation of the landing guidance system.

Bearing. The horizontal direction to or from any point usually measured clockwise from true north or some other reference point (see Non-Directional Beacon)(AIM).

Bends. Slow excursions of the course.

Bits per second (BPS). Refers to digital data transfer rate, usually by modem or direct cable.

Blind Speed. The rate of departure or closing of a target relative to the radar antenna at which cancellation of the primary target by MTI circuits in the radar equipment causes a reduction or complete loss of signal (AIM).

Blind Zones (Blind Spots). Areas from which radio transmissions and/or radar echoes cannot be received.

Broadband. Nonautomated signal processing.

Capture Effect. A system in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies.

Control Electronic Unit (CEU). Mobile MLS computer transmitter and monitoring system.

Change/Reversal in Slope of the Glidepath. A long term (1,500 ft or more) change in the direction of the *on-path* position as determined by the graphic averaging of the short term (roughness, high frequency scalloping) deviations as represented by the differential/corrected error trace.

Checkpoint. A geographical point on the surface of the earth whose location can be determined by reference to a map or chart.

Circular Polarization (CP). An electromagnetic wave for which the electronic and/or the magnetic field vector at a point describes a circle.

Note: Circular Polarization reduces or eliminates echoes from precipitation.

Clearance. The preponderance of the modulation signal appropriate to the area on one side of the reference line or point to which the receiver is positioned, over the modulation signal appropriate to the area on the other side of the reference line.

Clearance Guidance Sector. The volume of airspace, inside the coverage sector, within which the azimuth guidance information provided is not proportional to the angular displacement of the aircraft but is a constant fly-left or fly-right indication of the direction relative to the approach course the aircraft should proceed in order to enter the proportional guidance sector.

Close-in Courses. That portion of a course or radial which lies within 10 miles of the station.

Code Train. A series of pulses of similar characteristics and specific spacing. Applicable to the group of pulses transmitted by a transponder each time it replies to an interrogator.

Common Digitizer Data Reduction Program (CD). A computer data recording of raw narrowband radar data (minimal filtering ability is provided).

Cone of Ambiguity. Airspace over a VOR or TACAN station, conical in shape, in which the To/From ambiguity indicator is changing positions.

Control Motion Noise (CMN). Those fluctuations in the guidance which affect aircraft attitude, control surface, column motion, and wheel motion during coupled flight but do not cause aircraft displacement from the desired course or glidepath.

Cooperating Aircraft. Aircraft which cooperate by flying courses required to fulfill specific portions of the flight inspection and which meet the requirements for a small aircraft.

Cosecant-Squared Beam. A radar beam pattern designed to give approximately uniform signal intensity for echoes received from distant and nearby objects. The beam intensity varies as the square of the cosecant of the elevation angle.

Crosspointer (Deflection Indicator Current (ICAO)). An output current proportional to: ILS--Difference in depth of modulation measured in microamperes. VOR/VORTAC/TAC -- The difference in phase of two transmitted signals measured in degrees of two audio navigation components for a given displacement from a navigation aid.

Course Coincidence. The measured divergence of the designated radials of two adjacent facilities in the airway structure. (ICAO Document 8071).

Course Displacement. The difference between the actual course alignment and the correct course alignment. (ICAO Document 8071).

Course Error. The difference between the course as determined by the navigational equipment and the actual measured course to the facility. This error is computed as a plus or minus value, using the actual measured course to the facility as a reference.

Course Line Computer. Airborne equipment which accepts bearing and distance information from receivers in an aircraft, processes it, and presents navigational information enabling flight on courses other than directly to or from the ground navigation aid being used. (Used in Area Navigation--RNAV.)

Course Roughness. Rapid irregular excursions of the course usually caused by irregular terrain, obstructions, trees, power lines, etc.

Course Scalloping. Rhythmic excursions of the electromagnetic course or path.

Course Width (Course Sensitivity). The angular deviation required to produce a full-scale course deviation indication of the airborne navigation instrument.

Coverage. The designated volume of airspace within which a signal-in-space of specified characteristics is to be radiated.

Cycle Skip. The receiver uses the incorrect cycle of the 100 kHz carrier of the Loran-C signal, for time measurements. Normally the third cycle of a given carrier pulse is used for time measurements. Each cycle slip will result in a 10-microsecond error in time measurement and a corresponding error in navigation.

Dedicated TRIAD. Three specific Loran-C stations from one CHAIN. Dedicated TRIAD selection is utilized to ensure that receiver positioning is determined only by these stations.

Designed Procedural Azimuth. The azimuth determined by the procedure specialist that defines the desired position of a course or bearing.

DF Course (Steer). The indicated magnetic direction of an aircraft to the DF station and the direction the aircraft must steer to reach the station.

DF Fix. The geographical location of an aircraft obtained by the direction finder.

Difference in Depth of Modulation (DDM). The percentage modulation of the larger signal minus the percentage modulation of the smaller signal.

Discrepancy. Any facility operating parameter which is not within the given tolerance values (prescribed in the U.S. Standard Flight Inspection Manual) as determined by flight inspection measurements.

Displaced Threshold. A threshold located on the runway at a point other than the designated beginning of the runway (AIM).

Distance Measuring Equipment (DME). Electronic equipment used to measure, in nautical miles, the slant range of the aircraft from the navigation aid. (AIM)

Distance Measuring Equipment/Precision (DME/P). The range function associated with the MLS. It is a precision distance measuring equipment providing accurate range (20 to 40 ft at a 2-sigma probability).

DME Electronic Unit (DEU). Mobile MLS transmitter and monitoring system.

Doppler VOR (DVOR). VOR using the Doppler frequency shift principle.

Dual-Frequency Glidepath System. An ILS glidepath in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies within the particular glidepath channel, e.g., Capture Effect Glidepath.

Dual-Frequency Localizer System. A localizer system in which coverage is achieved by the use of two independent radiation frequencies within the particular localizer VHF channel.

Envelope to Cycle Discrepancy (ECD). The discrepancy between the desired and actual zero phase crossing at the end of the third cycle of the Loran-C 100 kHz carrier pulse.

Essential Data. Essential data words are Basic Data Words 1, 2, 3, 4, and 6; and Auxiliary Data Words A1, A2, and A3.

Expanded Service Volume (ESV). (See Service Volume.)

(Flight Facility). Any ground placed electronic equipment used to assist pilots in air navigation, landing approaches, or to direct air traffic movements. Flight facilities include NAVAID's, communications, and traffic control facilities.

Feed Horn. Radar antenna focal point. Also reference point in antenna elevation measurements.

Final Approach Segment. This is the segment in which alignment and descent for landing are accomplished. The final approach segment considered for obstacle clearance begins at the final approach fix or point and ends at the runway or missed approach point, whichever is encountered last. A visual portion within the final approach segment may be included.

Fixed Map. A background map on the radar display produced by one of the following methods:

(1) Engraved marks on an overlay illuminated by edge lighting

(2) Engraved fluorescent marks on an overlay illuminated by means of ultraviolet light.

(3) Projected on the display by means of film and a projector mounted above and in front of the scope.

(4) Electronically mixed into the display as generated by a "mapper" unit

Flag (Flag Alarm). A warning device in certain airborne navigation equipment and flight instruments indicating: (1) instruments are inoperative or otherwise not operating satisfactorily, or (2) signal strength or quality of the received signal falls below acceptable values. (AIM)

Flag Alarm Current. The d.c. current flowing in the Flag Alarm Circuit, usually measured in microamperes, which indicates certain characteristics of the modulation of the received signal.

Flight Inspection (Flight Check). Inflight investigation and evaluation of air navigation aids and instrument flight procedures to ascertain or verify that they meet established tolerances and provide safe operations for intended use.

> **Note:** *Flight checked* describes the procedure to accomplish the function of flight inspection. The two terms are interchangeable.

Flight Inspection Standard Service Volume (FISSV) (see Service Volume).

Fly-By Waypoint. A waypoint that requires the use of turn anticipation to avoid overshoot of the next flight segment.

Fly-Over Waypoint. A waypoint that precludes any turn until the waypoint is overflown.

Geometric Dilution of Precision (GDOP). A factor used to express navigational error at a position fix caused by divergence of the hyperbolic lines of position as the aircraft's receiver distance from the baseline increases. The larger the GDOP, the larger the standard deviation of position errors.

Glidepath. See: ILS Glidepath.

Glidepath Angle. The angle between the downward extended straight line extension of the ILS glidepath and the horizontal.

Glidepath Structure. Characteristics of a glidepath including bends, scalloping, roughness, and width.

Glide Slope. A facility which provides vertical guidance for aircraft during approach and landing.

Glide Slope Intercept Altitude. The true altitude (MSL) proposed or published in approved let-down procedures at which the aircraft intercepts the glidepath and begins descent. (FAA Order 1000.15 latest revision)

Graphical Average Path. The average path described by a line drawn through the mean of all crosspointer deviations. This will usually be a curved line which follows long-term trends (1,500 ft or greater) and averages shorter term deviations.

Ground Point of Intercept (GPI). A point in the vertical plan on the runway centerline at which it is assumed that the *downward straight line extension* of the glide path intercepts the runway approach surface baseline. (FAA Order 8260.3 latest revision)

Group Repetition Interval (GRI). The time interval (microseconds divided by 10) between one group of 100 kHz carrier pulses and the next, from any transmitter within a Loran-C CHAIN. All stations in a specific CHAIN use the same GRI.

Hertz (Hz). A unit of frequency of electromagnetic waves which is equivalent to one cycle per second. See Symbols in this chapter.

Kilohertz (kHz). A frequency of 1000 cycles per second.

Megahertz (MHz). A frequency of one million cycles per second.

Gigahertz (GHz). A frequency of one billion cycles per second.

Hole (Null). An area of signal strength below that required to perform the necessary function or furnish the required information, which is completely surrounded by stronger signal areas of sufficient strength to perform required functions.

ILS--Back-Course Sector. The *course sector* which is the appropriate reciprocal of the front *course sector.*

ILS--Commissioned Angle--Glide Slope. The glidepath angle calculated by a qualified procedure specialist which meets obstruction criteria (FAA Order 8260.3 latest revision). This nominal angle may be increased to meet additional criteria, i.e., engineering, noise abatement, site deficiencies, etc.

ILS--Commissioned Width--Localizer. The nominal width of a localizer. In practice the width is computed by using the criteria prescribed in Section 217 of FAA Order 8200.1 (latest revision).

ILS--Course Sector. A sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which 150uA is found.

ILS--Differential Corrected Trace. The trace on the recording which is the algebraic sum of the Radio Telemetering Theodolite (RTT) crosspointer (DDM) and the aircraft receiver crosspointer (DDM) and which is produced by the differential amplifier within the airborne Theodolite Recording System.

ILS--Downward Straight Line Extension. The mean location of the ILS Glidepath in zone 2.

ILS--Facility Reliability. The probability that an ILS ground installation radiates signals within the specified tolerances.

ILS--Front Course Sector. The course sector which is situated on the same side of the localizer as the runway.

ILS--Glidepath. The locus of points in the vertical plane (containing the runway centerline) at which the DDM is zero, which of all such loci is the closest to the horizontal plane.

Note: Offset ILS's do not contain the runway centerline.

ILS--Glidepath Sector. The sector in the vertical plane containing the ILS glidepath at which 150uA occurs.

Note: The ILS glidepath sector is located in the vertical plane containing the localizer *on-course* signal and is divided by the radiated glidepath called upper sector and lower sector, referring respectively to the sectors above and below the path.

ILS--Glidepath Sector Width (Normal Approach Envelope). The width of a sector in the vertical plane containing the glidepath and limited by the loci of points above and below the path at which reading of 150uA is obtained.

ILS--Half Course Sector. The sector, in a horizontal plan containing the course line and limited by the loci of points nearest the course line at which 75uA occurs.

ILS--Localizer Back Course Zone 1. The distance from the coverage limit to 4 miles from the localizer antenna.

ILS--Localizer Back Course Zone 2. From 4 miles from the localizer antenna to 1 mile from the localizer antenna.

ILS--Localizer Back Course Zone 3. One mile from the localizer antenna to the missed approach point, which may be as close as 3,000 ft from the localizer antenna.

ILS--Localizer Clearance Sector 1. From 0^{o} to 10^{o} each side of the center of the localizer *on-course.*

ILS--Localizer Clearance Sector 2. From 10^{o} to 35^{o} each side of the center of the localizer *on-course*.

ILS--Localizer Clearance Sector 3. From 35^{o} to 90^{o} each side of the center of the localizer *on-course*.

ILS--Localizer Course Sector Width. The sum of the angular distances either side of the center of the course required to achieve full scale (150uA) crosspointer deflection.

ILS--Lowest Coverage Altitude (LCA). That altitude which is final approach fix altitude, glidepath intercept altitude, or 500 ft above all obstructions, whichever is higher. For a back course used solely to provide missed approach guidance, it shall be a procedural altitude within 10 nm of the antenna, 1,500 ft above the antenna, or 500 ft above all obstructions, whichever is highest.

ILS--Performance Category I. An ILS which provides acceptable guidance information from the coverage limits of the ILS to the point at which the localizer course line intersects the glidepath at a height of 100 ft or less above the horizontal plane containing the runway threshold.

ILS--Performance Category II. An ILS which provides acceptable guidance information from the coverage limits of the ILS to the point at which the localizer course line intersects the glidepath at a point above the runway threshold.

ILS--Performance Category III. An ILS, which, with the aid of ancillary equipment where necessary, provides guidance information from the coverage limit of the facility to, and along, the surface of the runway.

ILS--Point "A". An imaginary point on the glidepath/localizer *on-course* measured along the runway centerline extended, in the approach direction, 4 nautical miles from the runway threshold.

NOTE: For back Course and installations sited to project a course substantially forward of threshold as in Figure 217-1B(2), this point is 4 nm from the antenna.

ILS--Point "B". An imaginary point on the glidepath/localizer *on-course* measured along the runway centerline extended, in the approach direction, 3,500 ft from the runway *threshold.*

NOTE: For back course as in Figure 217-1B(3), this point is 1 nm from the antenna. For installations sited to project a course substantially forward of threshold as in Figure 217-1B(2), this point is 1 nm from the threshold.

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ILS--Point "C". A point through which the *downward extended straight portion* of the glidepath (at the commissioned angle) passes at a height of 100 ft above the horizontal plane containing the *runway threshold*.

Note: Localizer only, Back Course, LDA's and SDF only facilities, Point C is the missed approach point and may not necessarily be the runway threshold.

ILS Point "D". A point 12 ft above the runway centerline and 3,000 ft from the runway threshold in the direction of the localizer.

ILS Point "E". A point 12 ft above the runway centerline and 2,000 ft from the stop end of the runway in the direction of the *runway threshold*.

ILS Point "T". A point at specified height located vertically above the intersection of the runway centerline and the *runway threshold* through which the *downward extended straight line* portion of the ILS glidepath passes.

ILS Reference Datum. Same as ILS Point "T".

ILS--Zone 1. The distance from the coverage limit of the localizer/glidepath to Point "A" (four miles from the *runway threshold).*

ILS--Zone 2. The distance from Point "A" to Point "B".

ILS--Zone 3. CAT I - The distance from Point "B" to Point "C" for evaluations of Category I ILS.

CAT II and III - The distance from Point "B" to the *runway threshold* for evaluations of Category II and III facilities.

Note: Localizer Only, Back Course, LDA, and SDF facilities will have no Zone 3 if Point “C” occurs prior to Point “B.” Structure tolerance remains defined by Points “A” to “B.”

ILS--Zone 4. The distance from runway threshold to Point "D".

ILS--Zone 5. The distance from Point "D" to Point "E".

Initial Approach Segment. In the initial approach, the aircraft has departed the en route phase of flight, and is maneuvering to enter an intermediate segment. This is the segment between the initial approach fix/waypoint and the intermediate fix/waypoint or the point where the aircraft is established on the intermediate course or final approach course.

Intermediate Approach Segment. This is the segment which blends the initial approach segment into the final approach segment. It is the segment in which aircraft configuration, speed, and positioning adjustments are made for entry into the final approach segment. The intermediate segment begins at the intermediate fix (IF) or point, and ends at the final approach fix (FAF).

In-Phase. Applied to the condition that exists when two signals of the same frequency pass through their maximum and minimum values of like polarity at the same time.

Integrity. That quality which relates to the trust which can be placed in the correctness of the information supplied by the facility.

Integrators. Received target enhancement process used in primary radar receivers.

Interrogator. The ground-based surveillance radar transmitter-receiver which normally scans in synchronism with a primary radar, transmitting discrete radio signals which repetitiously request all transponders, on the mode being used, to reply. The replies are displayed on the radar scope. Also applied to the airborne element of the TACAN/DME system. (AIM)

Investigator-in-Charge (IIC). Person responsible for on-site aircraft investigation procedure.

Joint Acceptance Inspection (JAI). Inspection at culmination of facility installation and preparation. System is technically ready for commissioning after successful JAI.

Joint Use. For this document, refer to radar sites used by both the FAA and military.

Line-of-Position (LOP). LOP is a hyperbolically curved line defined by successive but constant time difference measurements using the signals from two Loran-C transmitters. Two LOP's from two station pairs define the location of a receiver and establish a position fix.

Local Area Monitor (LAM). A stationary receiver designed to monitor and record Loran-C signals and time difference (TD) data. TD information obtained by this unit is used for calculating receiver TD calibration values.

Localizer Type Directional Aid (LDA). A facility of comparable utility and accuracy to a LOC, but which is not part of a full ILS and may not be aligned with the runway. (FAA Order 8260.3, latest revision)

Localizer (LOC). The component of an ILS which provides lateral guidance with respect to the runway centerline. (FAA Order 8260.3, latest revision).

Localizer Zones. See ILS-Zones or ILS-Localizer Back Course Zones

Lock-On. The condition during which usable signals are being received by the airborne equipment and presentation of steady azimuth and/or distance information starts.

Loran-C CHAIN. Loran-C stations are grouped into sets of stations called CHAINs. Each CHAIN consists of a master station and two or more secondary stations that repeat transmissions over a specific period of time (see GRI).

Loran Signal Evaluation System (LSES). The LSES is a Loran-C receiver and a time difference data device used to evaluate approach sites. The device determines if usable signals are present and establishes the time difference relationship with the local area monitor.

Loran-C Time Difference (TD). The elapsed time, in microseconds, between the arrival of two signals.

Lowest Coverage Altitude (LCA). See *ILS-Lowest Coverage Altitude (LCA).*

Maximum Authorized Altitude (MAA). A published altitude representing the maximum usable altitude or flight level for an airspace structure or route segment. It is the highest altitude on a Federal airway, Jet route, area navigation low or high route, or other direct route for which an MEA is designated in FAR Part 95, at which adequate reception of navigation and signals is assured.

Maximum Error. The maximum amplitude of course alignment from zero, either in the clockwise or counterclockwise direction.

Mean Course Error (MCE). The mean value of azimuth or elevation error along the approach course or specified glidepath.

Microampere(s). (Microamps)--One millionth of an ampere (amp). In practice, seen on a pilot's omnibearing selector (OBS), oscillograph recordings, and/or flight inspection meters, as a deviation of the aircraft's position in relation to a localizer on-course (zero DDM) signal or glidepath on-path (zero DDM) signal, e.g., "5 microamperes (?A) right" (localizer); "75?A low" (glidepath). See Crosspointer and Symbols in this section.

Microwave Landing System (MLS). The international standard microwave landing system.

Milliampere (mA). One one-thousandth of an ampere.

Minimum Crossing Altitude (MCA). The lowest altitude at certain fixes at which an aircraft must cross when proceeding in the direction of a higher minimum en route IFR altitude (MEA). (AIM)(See Minimum En Route IFR Altitude)

Minimum Descent Altitude (MDA). The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glidepath is provided. (AIM)

Minimum En Route IFR Altitude (MEA). The lowest published altitude between radio fixes which assures acceptable navigational signal coverage and meets obstacle clearance requirements between those fixes. The MEA prescribed for a Federal airway or segment thereof, area navigational low or high route, or other direct route applies to the entire width of the airway, segment, or route between the radio fixes defining the airway, segment, or route. (AIM) (FAR Parts 91 and 95).

Minimum Glide Path (MGP). The lowest angle of descent along the zero degree azimuth that is consistent with published approach procedures and obstacle clearance criteria.

Minimum Holding Altitude (MHA). The lowest altitude prescribed for a holding pattern which assures navigational signal coverage, communications, and meets obstacle clearance requirements. (AIM)

Minimum Obstruction Clearance Altitude (MOCA). The lowest published altitude in effect between radio fixes on VOR airways, off-airway routes, or route segments which meets obstacle clearance requirements for the entire route segment and which assures acceptable navigation signal coverage only within 25 statute miles (22nm) of a VOR. (AIM) (Refer to FAR Parts 91 and 95)

Minimum Radar Range. The shortest distance from the radar at which the aircraft can be clearly identified on each scan of the radar antenna system.

Minimum Reception Altitude (MRA). The lowest altitude at which an intersection can be determined. (AIM) (Refer to FAR Part 95)

Minimum Safe Altitude Warning (MSAW). A software function of the air traffic ARTS II/III computer that is site specific. MSAW monitors Mode-C equipped aircraft for obstacle separation. It is designed to generate both aural and visual alerts at the air traffic controller's display when an aircraft is at or predicted to be at an unsafe altitude.

MSAW Approach Path Monitor (APM). An area normally 1 nm wide, either side of final approach course or runway heading. An APM starts at approximately 5 nm (or final approach fix) from the approach end of runway. An altitude value is determined for obstruction clearance for each APM at the beginning and at the end of the APM. These two values provide MSAW protection as an aircraft descends along the approach path towards the runway. Parallel runways utilize the same APM. For a circling only SIAP, the APM starts at 5 nm (or FAF) from the closest landing surface, and terminates 1 – 2 nm from the closest landing surface.

MSAW General Terrain Map (GTM). The area within a 55-mile radius of an Airport Surveillance Radar in which Mode-C equipped aircraft are monitored by an MSAW computer software function for obstacle separation.

MSAW Bin. A 2 nm square area within an MSAW General Terrain Map; 4,096 bins make up an MSAW General Terrain Map.

MSAW Bin Altitude. An altitude that is determined by the highest obstacle within the MSAW bin, plus 500 ft.

Minimum Vectoring Altitude (MVA). The lowest MSL altitude at which an IFR aircraft will be vectored by a radar controller, except as otherwise authorized for radar approaches, departures and missed approaches. The altitude meets IFR obstacle clearance criteria. It may be lower than the published MEA along an airway or J-route segment. It may be utilized for radar vectoring only upon the controllers' determination that an adequate radar return is being received from the aircraft being controlled. Charts depicting minimum vectoring altitudes are normally available only to the controllers and not to pilots. (AIM)

Missed Approach Point (MAP). A point prescribed in each instrument approach procedure at which a missed approach procedure shall be executed if the required visual reference does not exist. (AIM: See Missed Approach and Segments of an Instrument Approach Procedure.)

Missed Approach Segment. The missed approach segment is initiated at the decision height in precision approaches and at a specified point in non-precision approaches. The missed approach must be simple, specify an altitude, and whenever practical, a clearance limit (end of the missed approach segment). The missed approach altitude specified in the procedure shall be sufficient to permit holding or en route flight.

MLS Approach Reference Datum. A point at a specified height located vertically above the intersection of the runway centerline and the threshold.

MLS Auxiliary Data. Data, transmitted in addition to basic data, that provide facilities maintenance equipment siting information for use in refining airborne position calculations and other supplementary information.

MLS Basic Data. Data transmitted by the facilities maintenance equipment that are associated directly with the operation of the landing guidance system.

MLS Coverage Sector. A volume or airspace within which service is provided by a particular function and in which the signal power density is equal to or greater than the specified minimum.

MLS Datum Point. The point on the runway centerline closest to the phase center of the approach elevation antenna.

MLS Function. A particular service provided by the MLS; e.g., approach azimuth guidance, approach elevation guidance, or basic data, etc.

MLS Mean Course Error. The mean value of the azimuth error along a specified radial of the azimuth function.

MLS Mean Glidepath Error. The mean value of the elevation error along a specified angle of the elevation function.

MLS Minimum Glidepath. The lowest angle of descent along the zero-degree azimuth that is consistent with published approach procedures and obstacle clearance criteria.

MLS-Point "A". An imaginary point on the minimum glidepath and commissioned azimuth radial, 4 nautical miles from the runway threshold.

MLS-Point "B". An imaginary point on the minimum glidepath and commissioned azimuth radial, 3,500 ft from the runway threshold.

MLS-Point "C". A point through which the downward extended straight portion of the glidepath passes at a height of 100 ft above the horizontal plane containing the runway threshold.

Note: Azimuth only facilities, Point C is the missed approach point.

MLS-Point "D". A point 12 ft above the runway centerline and 3,000 ft from the runway threshold in the direction of the azimuth station.

MLS-Point "E". A point 12 ft above the runway centerline and 2,000 ft from the stop end of the runway in the direction of the runway threshold.

MLS Proportional Guidance Sector. The volume of airspace within which the angular guidance information provided by a function is directly proportional to the angular displacement of the airborne antenna with respect to the zero angle difference.

MLS Reference Point. The point at which flight inspection begins to apply facility budget error tolerances. This will normally be either the ARD or MAP.

Mode. The letter or number assigned to a specific pulse spacing of radio signals transmitted or received by ground interrogator or airborne transponder components of the Air Traffic Control Radar Beacon System (ATCRBS). Mode A (military Mode 3), Mode C (altitude reporting), and Mode S (data link) are used in air traffic control. (See transponder, interrogator, radar.) (AIM)

ICAO-Mode (SSR) Mode. The letter or number assigned to a specific pulse spacing of the interrogation signals transmitted by an interrogator. There are five modes: A, B, C, D, and M--corresponding to five different interrogation pulse spacings.

Moving Target Detection (MTD). Type of moving target detection system (like MTI) based on digital storage map techniques. Used in newer primary radars.

Moving Target Indicator (MTI). Electronic circuitry that permits the radar display presentation of only targets which are in motion. A partial remedy for ground clutter.

MTI Reflector. A fixed device with electrical characteristics of a moving target which allows the demonstration of a fixed geographic reference on a MTI display. (Used to align video maps, azimuth reference, etc.)

Narrowband Radar Display. Computer generated display of radar signals.

National Flight Data Center (NFDC). A facility in Washington, D.C., established by FAA to operate a central aeronautical information service for the collection, validation, and dissemination of aeronautical data in support of the activities of government, industry, and the aviation community. The information is published in the National Flight Data Digest. (AIM: See National Flight Data Digest.)

National Transportation Safety Board (NTSB). Office responsible for aircraft accident investigations.

NAVAID. Any facility used in, available for use in, or designated for use in aid of air navigation, including landing areas, lights, any apparatus or equipment for disseminating weather information, for signaling, for radio direction finding, or for radio or other electronic communication, and any other structure or mechanism having a similar purpose for guiding or controlling flight in the air or the landing or takeoff of aircraft. (Re: Federal Aviation Act of 1958, as amended.) (AIM)

Nondirectional Beacon/Radio Beacon (NDB). An L/MF or UHF radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine his bearing to or from the radio beacon and "home" on or track to or from the station. When the radio beacon is installed in conjunction with the Instrument Landing System marker, it is normally called Compass Locator. (AIM)

Nonprecision Approach Procedure/ Nonprecision Approach. A standard instrument approach procedure in which no electronic glide slope is provided; e.g., VOR, TACAN, NDB, LOC, ASR, LDA, or SDF approaches. (AIM)

Notices to Airmen/Publication. A publication designed primarily as a pilot's operational manual containing current NOTAM information (see Notices to Airmen - NOTAM) considered essential to the safety of flight, as well as supplement data to other aeronautical publications. (AIM)

Notices to Airmen/NOTAM. A notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations. (AIM)

a. NOTAM (D) - A NOTAM given (in addition to local dissemination) distant dissemination via teletype writer beyond the area of responsibility of the Flight Service Station. These NOTAMS will be stored and repeated hourly until canceled.

b. NOTAM (L) - A NOTAM given local dissemination by voice (teletypewriter where applicable), and a wide variety of means such as: TelAutograph, teleprinter, facsimile reproduction, hot line, telecopier, telegraph, and telephone to satisfy local user requirements.

c. FDC NOTAM A notice to airmen, regulatory in nature, transmitted by NFDC and given all-circuit dissemination.

d. ICAO NOTAM. A notice, containing information concerning the establishment, condition, or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. (AIM)

Null. That area of an electromagnetic pattern where the signal has been intentionally canceled or unintentionally reduced to an unacceptable level.

Obstacle. An existing object, object of natural growth, or terrain at a fixed geographical location, or which may be expected at a fixed location within a prescribed area, with reference to which vertical clearance is or must be provided during flight operation. (AIM)

Obstacle Clearance. The vertical distance between the lowest authorized flight altitude and a prescribed surface within a specified area. (FAA Order 8260.19, latest revision)

Obstruction. An object which penetrates an imaginary surface described in FAR Part 77. (AIM) (Refer to FAR Part 77).

Omnibearing Selector (OBS). An instrument capable of being set to any desired bearing of an omnirange station and which controls a course deviation indicator.

On-Course. The locus of points in the horizontal plane in which a zero or on-course reading is received.

On-Path. Same as on-course but in the vertical plane. See ILS--Glidepath.

Operational Advantage. An improvement which benefits the users of an instrument procedure. Achievement of lower minimums or authorization for a straight-in approach with no derogation of safety are examples of an operational advantage. Many of the options in TERP's are specified for this purpose. For instance, the flexible final approach course alignment criteria may permit the ALS to be used for reduced visibility credit by selection of the proper optional course. (FAA Order 8260.3, latest revision)

Optimum Error Distribution. Best overall facility alignment error distribution to achieve maximum operational benefits (not necessarily a perfect balance of the errors).

Orbit Flight. Flight around a station at predetermined altitude(s) and constant radius.

Oscilloscope. An instrument for showing visually, graphic representations of the waveforms encountered in electrical circuits.

Out-of-Coverage Indication (OCI). A signal radiated into areas outside the intended coverage sector where required to specifically prevent invalid removal of an airborne warning indication flag in the presence of misleading guidance information.

Out of Tolerance Condition. See Discrepancy.

Path Following Error (PFE). The guidance perturbations which the aircraft will follow. It is composed of a path following noise and of the mean course error in the case of azimuth functions or the mean glidepath error in the case of elevation functions.

Path Following Noise (PFN). That portion of the guidance signal error which could cause aircraft displacement from the mean course line or mean glidepath as appropriate.

Pilot-Controlled Lighting. Airfield lighting systems activated by VHF transmissions from the aircraft.

Planned View Display (PVD). A display presenting computer generated information such as alphanumerics or video mapping.

Polarization Error. The error arising from the transmission or reception of a radiation having a polarization other than that intended for the system.

Primary Area. The area within a segment in which full obstacle clearance is applied. (FAA Order 8260.3, latest revision)

Proportional Guidance Sector. The volume of airspace within which the angular guidance information provided by a function is directly proportional to the angular displacement of the airborne antenna with respect to the zero angle reference.

"Q" Factor. See Actual Navigation Performance.

Quadradar. Ground radar equipment named for its four presentations.

a. Height Finding

b. Airport Surface Detection

c. Surveillance

d. Precision Approach

/R. RNAV and transponder with altitude encoding capability.

Radar Bright Display Equipment (RBDE). Equipment at the ARTCC which converts radar video to a bright raster scan (TV type) display.

Radar Data Analysis Software (RDAS). A generic term referring to many types of terminal and en route radar data analysis tools. (COMDIG, RARRE, DRAM, etc.)

Radar Plan Position Indicator (RAPPI). Maintenance display used with CD-1 common digitizers.

Radar/Radio Detecting and Ranging. A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulses.

a. Primary Radar. A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at that site for processing and display at an air traffic control facility.

b. Secondary Radar/Radar Beacon/ ATCRBS. A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) side are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder.

This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display at an air traffic control facility. (See Transponder, Interrogator.) (AIM**)**

c. ICAO-Radar. A radio detection device which provides information on range, azimuth, and/or elevation of objects.

(1) Primary Radar. A radar system which uses reflected radio systems.

(2) Secondary Radar. A radar system wherein a radio signal transmitted from a radar station initiates the transmission of a radio signal from another station.

Radar Resolution - Azimuth. The angle in degrees by which two targets at the same range must be separated in azimuth in order to be distinguished on a radar scope as individual returns.

Radar Resolution - Range. The distance by which two targets at the same azimuth must be separated in range in order to be distinguished on a radar scope as individual returns.

Radar Route. A flight path or route over which an aircraft is vectored. Navigational guidance and altitude assignments are provided by ATC. (See Flight Path, Route.) (AIM)

Receiver Autonomous Integrity Monitoring (RAIM). A technique whereby a civil GPS receiver/processor determines the integrity of the GPS navigation signals without reference to sensors or non-DoD integrity systems other than the receiver itself. This determination is achieved by a consistency check among redundant pseudorange measurements.

Range of Validity. Area around a local area monitor where published Loran-C receiver TD calibration values are valid.

Radial. A magnetic bearing extending from a VOR/VORTAC/TACAN navi gation facility. (AIM)

Range, Azimuth, Radar, Reinforced Evaluator (RARRE). An IBM 9020 radar diagonistic program which is used to evaluate narrowband radar.

Real Time Quality Check (RTQC). Internally generated test target in automated target processing devices (common digitizers, etc.)

Receiver Check Point. A specific point designated and published, over which a pilot may check the accuracy of his aircraft equipment, using signals from a specified station.

Recorder Event Mark. A galvo mark on a recorder related to a position or time, required for correlation of data in performance analysis.

Reference Radial. A radial, essentially free from terrain and side effects, designated as a reference for measuring certain parameters of facility performance.

Reference Voltage (VOR Reference Voltage). A 30 Hz voltage derived in the reference phase channel of the aircraft VOR receiver.

Required Navigation Performance (RNP). A statement of the navigation performance accuracy necessary for operation within a defined airspace.

RHO/THETA Position. Coordinate position described by distance and angle.

Ring-Around. A display produced on the scope by front, side, or back antenna lobes of the secondary radar system. It appears as a ring around the radar location and may occur when an aircraft transponder replies to ground interrogations while in close proximity to the antenna site.

Rotation (Correct Rotation). A condition wherein the transmitted azimuth angle increases in a clockwise direction.

Roughness. Rapid irregular excursions of the electromagnetic course or path.

Runway Approach Surface Baseline. An imaginary plane down the runway at the height of the runway surface at threshold.

Runway Environment. The runway threshold or approved lighting aids or other markings identifiable with the runway. (FAA Order 8260.3)

Runway Point of Intercept. The point where the extended glide slope intercepts the runway centerline on the runway surface.

Runway Reference Point. Where VGSI angle of visual approach path intersects runway profile (see RPI).

Runway Threshold. The beginning of that portion of the runway usable for landing. (AIM) (When used for flight inspection purposes, displaced threshold(s) or threshold mean the same thing.)

Scalloping. See Course Scalloping. (FAA Order 1000.15, latest revision)

Search (DME/TACAN). Rapid movement of the distance or bearing indicators during the period in which either is unlocked. (FAA Order 1000.15, latest revision)

Secondary Area. The area within a segment in which required Obstruction Clearance (ROC) is reduced as distance from the prescribed course is increased (FAA Order 8260.3, latest revision).

Segment. The basic functional division of an instrument approach procedure. The segment is oriented with respect to the course to be flown. Specific values for determining course alignment, obstacle clearance areas, descent gradients, and obstacle clearance requirements are associated with each segment according to its functional purpose. (FAA Order 8240.3, latest revision)

Sensing (Correct Sensing). A condition wherein the ambiguity indicator gives the correct To/From indication.

Sensitivity Time Control (STC). Procedure used to vary receiver sensitivity with range. Gain is reduced as a function of decreasing range, in an attempt to make all radar replies uniform. (Gain would be maximum to maximum range in this event.)

Service Volume/SV. That volume of airspace surrounding a NAVAID within which a signal of usable strength exists and where that signal is not operationally limited by co-channel interference.

Note: For VOR/TACAN/DME and ILS, the following definitions are used:

a. Standard Service Volume (SSV) - That volume of airspace defined by the national standard.

b. Flight Inspection Standard Service Volume (FISSV) is defined as follows: On "T" class facilities, this FISSV is 25 nm and 1,000 ft (2,000 ft in designated mountainous areas) above site elevation or intervening terrain. On "L" and "H" class facilities, the distance extends to 40 nm, and the altitudes are the same as for the "T" class. The FISSV is used to determine the performance status of VOR/TAC/DME facilities.

c. Expanded Service Volume (ESV) - That additional volume of airspace outside the standard service volume requested by the FAA's Air Traffic Service or procedure specialist and approved by frequency management of the Airway Facilities Division and flight inspection for operational use.

d. Operational Service Volume (OSV) - The airspace available for operational use. It includes the following:

(1) The SSV excluding any portion of the SSV which has been restricted.

(2) The ESV.

Short-Term Excursions. Excursion characteristics of a navigation on-course or on-path signal which includes scalloping, roughness, and other aberrations but excludes bends.

Side Bands. The separated and distinct signals that are radiated whenever a carrier frequency is modulated. In terms of most air navigation facilities, double sidebands are present. This means that frequencies above and below the carrier frequency differing by the amount of the modulating frequencies are present. These sidebands contain intelligence for actuating navigation instruments.

Simplex. Single channel operation usually referred to at those sites using a single channel where dual channel (diplex) operation is available.

Splits. Two or more beacon targets generated from a single target reply. An undesirable condition due to problems in the beacon transmitter, antenna, propagation, aircraft transponder, or processing equipment.

Simplified Directional Facility/SDF. A NAVAID used for nonprecision instrument approaches. The final approach course is similar to that of an ILS localizer.

Slant Range. The line-of-sight distance between two points not at the same elevation.

Stagger. A feature used with primary MTI radar systems to vary the PRF at pre-selected intervals. This moves the inherent blind speed to a less troublesome value.

Standard VOT. A facility intended for use on the ground only (See VHF Omnidirectional test range).

Structure. Excursion characteristics of a navigation on-course or on-path signal which includes bends, scalloping, roughness, and other aberrations.

Structure Below Path. An angular measurement of clearance below path.

Subclutter Visibility. A performance characteristic of the system to detect a moving target in the presence of relatively strong ground clutter.

Symbols.

G	10^{9} times (a unit); giga
M	10^{6} times (a unit); mega
k	10^{3} times (a unit); kilo
h	10^{2} times (a unit); hecto
dk	10 times (a unit); deca
d	10^{-1} times (a unit); deci
c	10^{-2} times (a unit); centi
m	10^{-3} times (a unit); milli
?	10^{-6} times (a unit); micro
n	10^{-9} times (a unit); nano
??	10^{-12} times (a unit); micromicro
?	Commissioned angle
?	Sum; Sum of; algebraic sum of:
?	Greater than:
?	Less than
?	Equal to or greater than:
?	Equal to or less than:
=	equals:
?	ratio; ratio of:
?	therefore:

Symmetry. (ILS)? ICAO: Displacement sensitivity. A ratio between individual width sectors (90 Hz and 150 Hz) expressed in percent.

Systems Performance Analysis Rating (SPAR). A rating based on performance or expected performance. These ratings are related to flight inspection intervals as follows:

SPAR Class 1, 90-day interval; Class 2, 180-day interval; Class 3, 270-day interval.

TACAN Distance Indicator (TDI). A unit of airborne equipment used to indicate distance from a selected facility.

Target of Opportunity. An itinerant aircraft operating within the coverage area of the radar and which meets the requirements for a small aircraft as described in FAA Order 8200.1 (latest revision) Section 215.

Target Return. The return signal transmitted by a beacon-equipped aircraft in reply to the ground facility interrogator. Also, indication shown on a radar display resulting from a primary radar return.

Threshold. See Runway Threshold.

Touchdown Zone (TDZ). The first 3,000 ft of runway beginning at the threshold. (See FAA Order 8260.3, latest revision).

Touchdown Zone Elevation. The highest runway centerline elevation in the touchdown zone.

Tracking. Condition of continuous distance or course information.

Transponder. The airborne radar beacon receiver/transmitter portion of the Air Traffic Radar Beacon System (ATCRBS) which automatically receives radio signals from interrogators on the ground, and selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond. (See Interrogator.) (AIM)

Trend. The general direction or incline of a segment of the glidepath which persists for a distance of 1,500 ft or more along the approach course.

Un-Lock. Condition at which the airborne interrogator (TACAN) discontinues tracking and starts search.

Usable Distance. The maximum distance at a specified altitude at which the facility provides readable identification and reliable bearing or glidepath information under average atmospheric condition.

Variable Voltage (VOR Variable Voltage). A 30 Hz voltage derived in the variable phase channel of the aircraft VOR receiver.

Vertical Angle. An angle measured upward from a horizontal plane.

VHF Omnidirectional test range (VOT). A radio transmitter facility in the terminal area electronic navigation systems, radiating a VHF radio wave modulated by two signals having the same phase relationship at all azimuths. It enables a user to determine the operational status of a VOR receiver. (See Standard VOT and Area VOT.)

Video Map. An electronic displayed map on the radar display that may depict data such as airports, heliports, runway centerline extensions, hospital emergency landing areas, NAVAIDs and fixes, reporting points, airway/route centerlines, boundaries, handoff points, special use tracks, obstructors, prominent geographic features, map alignment indicators, range accuracy marks, and minimum vectoring altitudes (AIM).

Visual Descent Point (VDP). The visual descent point is a defined point on the final approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided visual reference is established. (AIM)

VORTAC. A facility composed of azimuthal information from both VOR and TACAN, plus distance information of TACAN.

VOT? **Standard.** See Standard VOT.

VOT? **Area Use.** See Area VOT.

VOT Reference Point. A point on or above an airport at which the signal strength of a VOT is established and subsequently checked (applies to both standard and area VOTs).

Waveform. The shape of the wave obtained when instantaneous values of an a.c. quantity are plotted against time in rectangular coordinates.

Waveguide. A hollow pipe usually of rectangular cross section used to transmit or conduct RF energy.

Wavelength. The distance usually expressed in meters traveled by a wave during the timer interval of one complete cycle. Equal to the velocity divided by the frequency.

9960 Hz Voltage. A voltage derived from the VOR 9960 amplitude modulation by the reference channel of the VOR receiver. The 9960 Hz AM is a subcarrier which is frequency modulated by the 30Hz reference. Also referred to the 10 kHz sub-carrier.

301.2 ABBREVIATIONS, ACRONYMS, AND LETTER SYMBOLS.

A	: Ampere
a.c.	: alternating current
AC	: advisory circular
ADF	: automatic direction finding
ADP	: automatic data processing
AER	: approach end of runway
AF	: Airway Facilities
AFB	: Air Force Base
AFC	: automatic frequency control
AFIS	: automated flight inspection system
AGC	: automatic gain control
AGL	: above ground level
AIM	: Airmen's Information Manual
air	: airborne
align	: alignment
ALS	: approach lighting system
ALSF	: approach lighting system with sequenced flashing lights
am.	: ammeter
AM	: amplitude modulation
amp	: Ampere
ANF	: air navigation facility
ANP	: actual navigation performance
ant	: antenna
APM	: Approach Path Monitor
APPCON	: approach control
ARAC	: Army radar approach control
ARD	: approach reference datum
ARG	: auxiliary reference group
ARR	: automated flight inspection system reference radial
ARSR	: air route surveillance radar
ARTCC	: air route traffic control center
ARTS	: automated radar terminal system
ASBL	: approach surface baseline
ASIS	: Aviation Standards Information System
ASOS	: automated surface aviation observing system
ASR	: airport surveillance radar
AT	: air traffic
ATC	: air traffic control
ATCALS	: Air Traffic Control and Landing System
ATCRBS	: Air Traffic Control Radar Beacon System
ATIS	: Automatic Terminal Information Service
ATKER	: along track error
AVN	: Office of Aviation System Standards
AWOS	: automatic weather observation system
az	: azimuth
Az-El	: azimuth-elevation
Baz	: back azimuth horizontal guidance
BCM	: back course marker
bcn	: beacon
BFTA	: beacon false target analysis
BPS	: bits per second
BIT	: a digit in a binary coded decimal
BRITE	: brite radar indicator tower equipment
BUEC	: backup emergency communications
BW	: beam width
c	: centi (=10^{-2})
C	: Celsius
?C	: degrees Celsius
C/A code	: coarse/acquisition code
cal	: calibrate, calibrated
CAS	: calibrated airspeed
CAT	: category
CCW	: counterclockwise
CD	: common digitizer
CDI	: course deviation indicator
CDU	: control display unit
CEU	: control electronic unit
CHAIN	: a group of Loran C stations
chan	: channel
chg	: change
CIC	: combat information center
CL	: centerline
Comm	: Commission
CMLSA	: Commercial MLS Avionics
CMN	: control motion noise
COMDIG	: common digitizer data reduction
COMLO	: compass locator
CONUS	: continental United States
COP	: change-over-point
CTOL	: conventional takeoff and landing
CP	: circular polarization
CW	: clockwise
d	: deci (=10^{-1})
DA	: decision altitude
DAME	: distance azimuth measuring equipment
db	decibel
dB/Hz	: Decibel/Hertz
dbm	: decibel referred to 1 milliwatt
DBRITE	: Digital Bright Radar Indicator Tower Equipment
dbw	: decibel referred to 1 watt
d.c.	: direct current
DDM	: difference in depth of modulation
DEU	: DME electronic unit
DF	: direction finding
DFL	: Daily Flight Log
DGPS	: differential global positioning system
DH	: decision height
disc	: discrepancy

DME : distance measuring equipment
DME/N : distance measuring equipment/ non precision (standard DME)
DME/P : distance measuring equipment/ precision
DOD : Department of Defense
DOT : Department of Transportation
DP : departure procedure
DPSK : differential phase shift keying
DVOR : doppler very high frequency omni-directional range

E. : East
EARTS : en route automated radar tracking service
ECD : envelope to cycle discrepancy (difference)
ECOM : enroute communications
ECM : electronic counter measures
EFIS : electronic flight instrument system
e.g. : exempli gratia (for example)

el : elevation
EMI : electromagnetic interference
ESV : expanded service volume
et al. : et alibi (and elsewhere; et alii (and others)
etc. : etcetera (and the rest; and so forth)

F : Fahrenheit
?F : degrees Fahrenheit
FAA : Federal Aviation Administration
FAC : final approach course
FAF : final approach fix
FANS : Future Air Navigation System (ICAO)
FAP : final approach point
FAR : Federal Aviation Regulations
FAS : final approach segment
FAWP : final approach waypoint
FBWP : flyby waypoint
FICO : Flight Inspection Central Operations
FIP : Flight Inspection and Procedures (staff)
fig. : figure
FM : fan marker
FM : frequency modulation
FMS : flight management system
FOWP : flyover waypoint
freq : frequency
FSS : flight service station
FTC : fast time constant

G : giga (=10^9)
galv : galvanometers
GCA : ground contolled approach
GDOP : geometric dilution of precision
GHz : gigahertz
GLS : GPS landing system
govt. : government
Gnd : ground
GNSS : Global Navigation Satellite System
GPI : ground point of intercept
GRI : ground repetition interval
GS : glide slope
GSI : glide slope intercept altitude (Point)
GTC : gain time control
GTM: : General Terrain Map

h : hecto (-10^2); hour
H : homer
HAA : height above airport elevation
HAT : height above touchdown
H-Class : high altitude
HDOP : horizontal dilution of precision
HF : high frequency
HF/DF : high frequency/direction finding
HFOM : horizontal figure of merit
HIRLS : high intensity runway lighting system
HIWAS : Hazardous Inflight Weather Advisory Service
Hz : Hertz

IAC : initial approach course
IAF : initial approach fix
IAS : indicated airspeed
IAWP : initial approach waypoint
IC : intermediate course
ICAO : International Civil Aviation Organization
IIC : investigator-in-charge
ID : identification
i.e. : id est (that is)
IF : intermediate fix
IFIO : International Flight Inspection Office
IFR : Instrument Flight Rules
IFSS : international flight service stations
ILS : instrument landing system
IM : inner marker
INS : inertial navigation system
IO : input-output
IRU : inertial reference unit
ips : inches per second
ISLS : improved side lobe suppression
IWP : intermediate waypoint

JAI : joint acceptance inspection

JSS : joint surveillance site

k : Kilo (=10^3)
kHz : kilohertz
KIAS : knots indicated airspeed
kn : knots
kW : kilowatt

LAM : local area monitor
lat. : latitude

LCA : lowest coverage altitude
L-Class : low altitude VOR
LDA : localizer directional aid
LDIN : lead-in lights
LEPP : live environment performance program
LF : low frequency
LMM : compass locator at middle marker
LOC : localizer
LOM : compass locator at outer marker
long. : longitude
LOP : line-of-position
Loran : long range navigation
LOS : line of site
LP : linear polarization
LRCO : limited remote communications outlet
LSES : loran signal evaluation system

m : meter
M : mega (=10^6)
mA : milliampere
MAA : maximum authorized altitude
MAHP : missed approach holding point
MAHWP : missed approach holding waypoint
MALS : medium intensity approach lights? 5,000 cp
MALSF : medium intensity approach lights; sequenced flashing lights
MALSR : same as MALSF; runway alignment indicator lights
MAP : missed approach point
MATWP : missed approach turning waypoint
MAWP : missed approach waypoint
MB : marker beacon
MCA : minimum crossing altitude
MCE : mean course error
MDA : minimum descent altitude
MDP : MLS datum point
MEA : minimum en route altitude
MF : medium frequency
MGP : minimum glide path
MHA : minimum holding altitude
Mhz : megahertz
MIRL : medium intensity runway lights
MLS : microwave landing system
MM : middle marker
MOCA : minimum obstruction clearance altitude
MRA : minimum reception altitude
MOPS : minimum operational performance standards
MRG : main reference group
MSAW : minimum safe altitude warning
MSG : minimum selectable glidepath
MSL : mean sea level
MTD : moving target detection
MTI : moving target indicator
MTR : mission test report
MSAW : minimum safe altitude warning
MUA : maximum usable altitude
mV : millivolt
MVA : minimum vectoring altitude
MVAR : magnetic variation

n : nano (=10^{-9})
N. : North
NA : not applicable or not authorized (when applied to instrument approach procedures)
NAS : National Airspace System
NASE : Navigational Aids Signal Evaluator
NAVAID : air navigation facility
NDB : nondirectional beacons
NFDC : National Flight Data Center
nm : nautical mile
NOTAM : Notice to Airmen
NRKM : nonradar keyboard multiplexer
NTSB : National Transportation Safety Board

OBS : omnibearing selector
OCI : out of coverage indication
ODALS : omnidirectional approach lighting system
OM : outer marker
orb. : orbit
OVLY XTKER : GPS overlay crosstrack error

PAPI : precision approach path indicator
P code : precision code
PAR : precision approach radar
PD : power density
PDOP : precision dilution of position
PE : permanent echo
PFE : path following error
PFN : path following noise
PIDP : programmable indicator data processor
PPI : plan position indicator
PPS : precise positioning service, P-code
PRF : pulse-repetition frequency
PRN : pseudo-range number
PT : procedure turn
PVD : plan view display

QARS : quick analysis of radar sites

RADAR or radar : radio range and detecting
RADES : Radar Evaluation Squadron (military)
RAG : range and azimuth gating
RAIL : runway alignment indicator light

RAIM	: receiver autonomous integrity monitoring
RAPCON	: radar approach control (USAF)
RAPPI	: Radar plan position indicator
RARRE	: range, azimuth radar reenforced evaluator
RATCC	: radar approach control center (USN)
RBDE	: radar bright display equipment
RCAG	: remote, center air/ground communication facility
RCO	: remote communication outlet
RDAS	: radar data analysis software
RDH	: reference datum height
rec	: receiver
ref	: reference
REIL	: runway end identifier light
RF	: radio frequency
RFI	: radio frequency interference
RMI	: radio magnetic indicator
RML	: radar microwave link
RNAV	: area navigation
RNP	: required navigation performance
ROC	: required obstruction clearance
RPI	: runway point of intercept
RPM	: revolutions per minute
RRP	: runway reference point
RSCAN	: radar statistical coverage analysis system
RTQC	: real time quality check
R/T	: receiver-transmitter
RTT	: radio telemetering theodolite
RVR	: runway visual range
RVV	: runway visual value
RWY	: runway
s	: second
S.	: South
SA	: selective availability
SALS	: short approach light system
SAVASI	: simplified abbreviated visual approach slope indicator system
SDF	: simplified directional facility
sec	: second
SECRA	: secondary radar
SER	: stop end of runway
SIAP	: standard instrument approach procedure
SID	: standard instrument departure
SINE	: site integration of NAS equipment
SLS	: side lobe suppression
SNR	: Signal-to-noise ratio
SNR-FS	: Signal-to-noise ratio-field strength
SNR-PH	: Signal-to-noise ratio-phase
SPAR	: system performance analysis rating
SPS	: standard positioning service, C/A code
SSALF	: simplified short approach light system; sequenced flashing lights
SSALR	: same as SSALF; runway alignment indicator lights
SSV	: standard service volume
STAR	: standard terminal arrival route
STC	: sensitivity time control
STOL	: short takeoff and landing
TACAN	: tactical air navigation
TAR	: test analysis report
TCH	: threshold crossing height
T-Class	: terminal VOR, TACAN, or VORTAC
TCOM	: terminal communications
TD	: time difference
TDI	: TACAN distance indicator
TDM	: time division multiplex
TDR	: touchdown reflector
TDZ	: touchdown zone
TDZL	: touchdown zone lights
TERPS	: terminal instrument procedures
TH	: threshold
TLS	: Transponder Landing System
TOWP	: take-off waypoint
T/R	: transponder-radar (system)
TRACALS	: traffic control and landing systems
TRACON	: terminal radar approach control (FAA)
TRIAD	: 3 Loran C stations of a specific chain
TRSB	: time reference scanning beam
T-VASI	: T (configuration)? visual approach slope indicator
TVOR	: terminal VOR
TWEB	: transcribed weather broadcast equipment
u	: micro
UDF	: ultra high frequency direction finder
UHF	: ultra high frequency
USA	: United States Army
USN	: United States Navy
USAF	: United States Air Force
USSFIM	: United States Standard Flight Inspection Manual
UTC	: universal coordinated time
V	: volt
var.	: variation
VASI	: visual approach slope indicator
VDF	: very high frequency direction finder
VDOP	: vertical dilution of precision
VDP	: visual descent point
VFR	: visual flight rules
VGSI	: visual glide slope indicator
VHF	: very high frequency
VLF	: very low frequency
VNAV	: vertical navigation
VOR	: very high frequency omni-directional range

VORDME	: very high frequency omnidirectional range, distance measuring equipment
VOT	: very high frequency omnidirectional range test
VP	: vertical polarization
V/STOL	: vertical/short takeoff and landing
VORTAC	: very high frequency omnidirectional range, tactal air navigation
W	: watt
W.	: West
WGS-84	: World Geodetic Survey of 1984
WPDE	: waypoint displacement error
WP	: waypoint
Xmtr	: transmitter
XTK	: receiver cross-track information
XTKER	: crosstrack error
Z	: zulu time (Greenwich mean time)

SECTION 302. FORMULAS

TABLE OF CONTENTS

SECTION 302. FORMULAS

302.1 Introduction. The following formulas and methods of calculation are presented as a ready reference.

302.2 General. The following information is of a general nature, and use of it may be applicable to more than one facility.

a. Constants Used in this Order. Following is a list of constants used in this order. Others are unique to a particular formula and can be found in reference material concerning the subject.

Constant	Definition/Derivation
6076.1	feet per nautical mile
3600	seconds per hour
106	tan 1° (6076.1)
0.00943	$\frac{1}{\tan 1^\circ (6076.1)}$
0.0159	$\frac{6076.1}{(3600)(106)}$
0.592	$\frac{3600}{6076.1}$

b. Rounding. Measurements and calculations should be carried to one decimal place more than that required for tolerance application. Then apply the following criteria to round off a measurement.

Numbers 1 to 5 - round off to zero
Numbers 6 to 9 - round off to the next higher value.

Example: Glidepath Course Width:

$0.755^\circ = 0.75^\circ$ and
$0.756^\circ = 0.76^\circ$

Exception: When a value exceeds a tolerance, it should not be rounded off to an in-tolerance condition.

Example: Glidepath Course Width:

= 0.903° is out of tolerance.

c. Time Average

$$T_{av} = \frac{2(T_1 \times T_2)}{(T_1 + T_2)}$$

Where:

T_{av} = Time average
T_1 = Time to cross in one direction
T_2 = Time to cross in opposite direction

d. Conversion of Knots to Feet per Second

$$V = \frac{6076.1 \times V_k}{3600}$$

Where:
V = Velocity (ft per sec)
V_k = Velocity (knots)

e. Slant Angle

$$\angle = \text{arc tan } \frac{A}{D}$$

Where:
A = Altitude above the horizontal (ft)
D = Geodetic distance (ft)
∠ = Slant Angle (degrees)

f. Slant Range to Chart Distance

$$S = \frac{D}{\cos \angle}$$

Where:
D = Geodetic distance (ft)
S = Slant range distance (ft)
∠ = Slant Angle (degrees)

g. Chart Distance to Slant Range

$$D = S \cos \angle$$

Where:
D = Geodetic distance (ft)
S = Slant range distance (ft)
∠ = Slant angle (degrees)

h. Radio Line of Sight

$$D = 1.23\ (\sqrt{H_r} + \sqrt{H_t})$$

Where:
D = Radio Line of Sight Distance (nm)
Hr = Height of receiving antenna (ft)
Ht = Height of transmitting antenna (ft)

I. Earth Curvature

$$Ec = (D)^2(0.883)$$

Where:
Ec = Earth Curvature (ft)
D = Distance from a point (nm)

302.3 TACAN

Modulation Percentage 135 and 15 Hz

$$15\text{ Hz modulation} = \frac{(V_1 + V_2) - (V_3 + V_4)}{(V_1 + V_2) + (V_3 + V_4)}$$

$$135\text{ Hz modulation} = \frac{(V_1 + V_3) - (V_2 - V_4)}{(V_1 + V_2) + (V_3 + V_4)}$$

Where:
V_1 = Max of 135 Hz and 15 Hz
V_2 = Min of 135 Hz at max of 15 Hz
V_3 = Max of 135 Hz and 15 Hz at min 15 Hz
V_4 = Min 135 and 15 Hz at min 15 Hz

302.4 Markers (75 MHz)

Marker Width

$$W_{ft} = \frac{(TAS)(T_{av})}{0,592} \quad \text{or}$$

$$W_{ft} = \frac{(G_s)(T)}{0.592} \quad \text{or}$$

$$W_{nm} = \frac{(TAS)(T_{av})}{3600}$$

Where:
G_s = Ground Speed (knots)
W_{ft} = Width (ft)
W_{nm} = Width (nm)
T = Time (sec)
TAS = True Airspeed (knots)
T_{av} = Time Average (sec)

302.5 Radar

Blind Speed using Non-Staggered or Uniform Pulse

$$V = \frac{291(PRF)}{F}$$

Where:
V = Groundspeed (knots)
PRF = Pulse Repetition Frequency (pulses/sec)
F = Transmitter Frequency (Mhz)

302.6 Localizer

a. Course Width

$$W = \frac{0.0159(ETAS)(T_{av})}{D}$$

Where:
W = Width (degrees)
ETAS = Effective True Airspeed (knots)
T_{av} = Time Average for course crossing (sec)
D = Distance from the localizer antenna to the point where the aircraft cross the localizer course (nm to the nearest thousandth)

Computed true airspeed (TAS) may be used if correction for crosswind component is applied from Figure 303-3.

b. Determining Localizer Tailored Width

$$W = 2\left(\arctan\left(\frac{350}{D}\right)\right)$$

Where:
W = Tailored Width (degrees)
D = Distance from the localizer antenna to the runway threshold (ft)

c. Dual Frequency Localizer Power Ratio

$$dB = 20 \log \frac{E_1}{E_2}$$

Where:
dB = Power ratio (dB)
E_1 = Signal Strength of course transmitter as read from the AGC Meter (μvolts)

E_2 = Signal Strength of clearance transmitter as read from the AGC Meter (μvolts)

302.7 Glide Slope

Glidepath Width or Angles

$$\theta = \text{arc tan } \frac{A}{D \pm F}$$

Where:
θ = Angle (degrees)
A = Absolute (Tapeline) altitude (ft) above the glide slope antenna
D = Geodetic distance (ft) from the glide slope antenna to the outer marker (or checkpoint)

$$F = 6076.1 \left(\frac{V}{3600}\right) T$$

NOTE: F is a factor. The value and sign (plus or minus) is determined by the location of the computation point on the recording.

- Assign a minus value to F if T occurs between the outer marker (or checkpoint) and the facility
- Assign a plus value to F if T occurs prior to the outer marker (or checkpoint)

V = Ground speed (knots)
T = Time to computation point (e.g., 75*u*A, 150HZ, 0*u*A, 75*u*A 90Hz for path width, and angle)

302.8 Precision Approach

a. Level Run Glidepath Angle (using paper units)

$$(1)\ \theta = \frac{A(0.00943)}{D}$$

Where:
θ = Glidepath Angle (degrees)
A = Absolute (Tapeline) altitude (ft) above the glide slope antenna
D = Distance from the Runway Point of Intercept (RPI) to the point where the glidepath is crossed (nm to the nearest thousandth)

$$(2)\ \theta = \frac{A(I_1)}{106(D)(I_2)}$$

Where:
θ = Glidepath Angle (degrees)
A = Absolute (Tapeline) altitude (ft) above the glide slope antenna
I_1 = Inches or units of recording paper from surveyed checkpoint to RPI
I_2 = Inches or units of recording paper from RPI to the point where the glidepath is crossed
D = Distance from the Runway Point of Intercept (RPI) to the point where the glidepath is crossed (nm to the nearest thousandth)

b. Altimetry Method

$$\text{Measured Angle} = \frac{A1}{106 \times D}$$

Where: A1 = Tapeline altitude in feet
D = Distance in nautical miles from RPI

302.9 Procedures

Gradient and Climb Rates

$$\frac{Cfd}{60} : \frac{Gr}{1} : \frac{Cr}{Gs}$$

Where:
Cfd = Climb rate (ft/nm)
Gr = Gradient (in percent/100)
Cr = Rate of Climb (ft/min)
Gs = Ground Speed (knots)

This formula is expressed as a ratio which can be solved directly on a pilot's computer (e.g., Jeppson CR-3)

302.10 MLS PFE/PFN/CMN Angular Tolerance

$$\theta = \text{arc tan } \frac{Tf}{D}$$

Where:
θ = Angular Tolerance at measure point.
Tf = PFE/PFN/CMN Tolerance in feet
D = Distance in feet from Azimuth antenna to Tolerance reference Point (ARD or MAP).

302.11 FMS Waypoint DME Evaluation Orbit/Arc Radius.

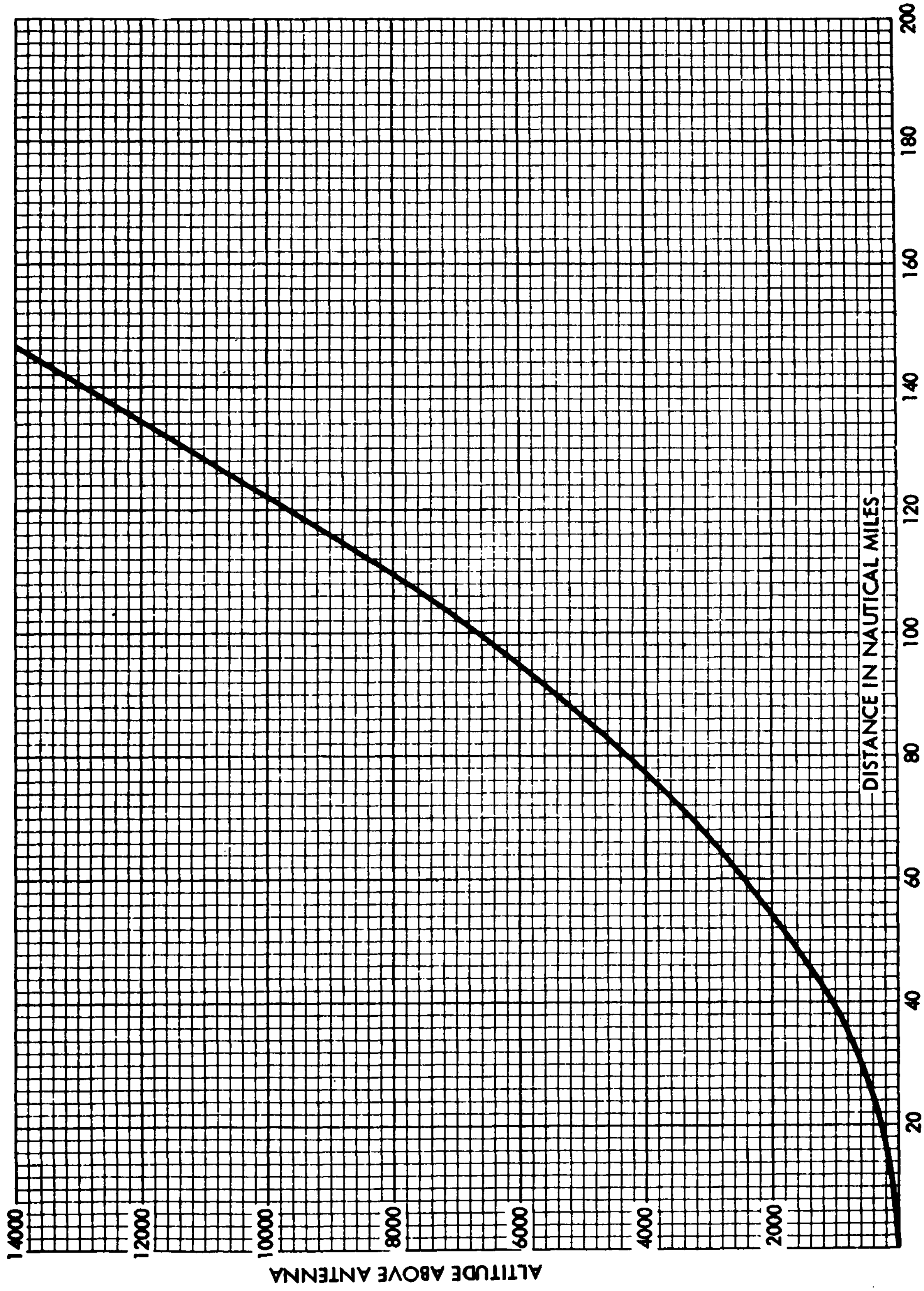
R = 0.0125D +0.25NM + XTRK

Where:
R = Radius in NM of orbit or arc
D = Distance in NM from the DME station farthest from the waypoint.
XTRK = Waypoint design criteria from Order 8260.40

NOTE: The XTRK value is .6 NM for Initial Approach, Intermediate, Final Approach, Missed Approach, and missed approach holding waypoints, 2.0 NM for feeder waypoints, and 3.0 NM for en route waypoints.

SECTION 303. WORKING GRAPHS AND CHARTS

RADIO LINE OF SIGHT CHART
Figure 303-1



CORRECTION FOR EARTH CURVATURE
Figure 303-2

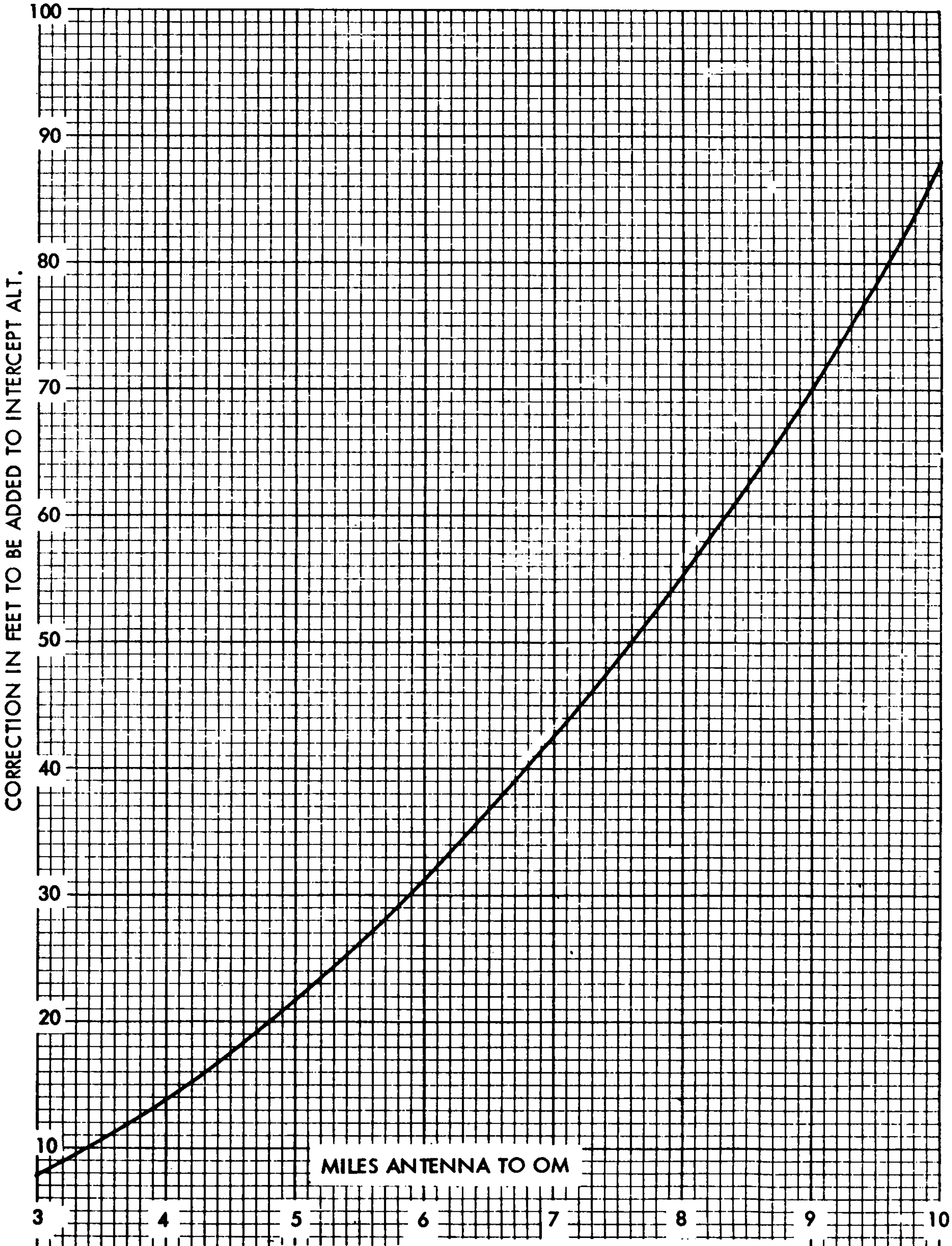
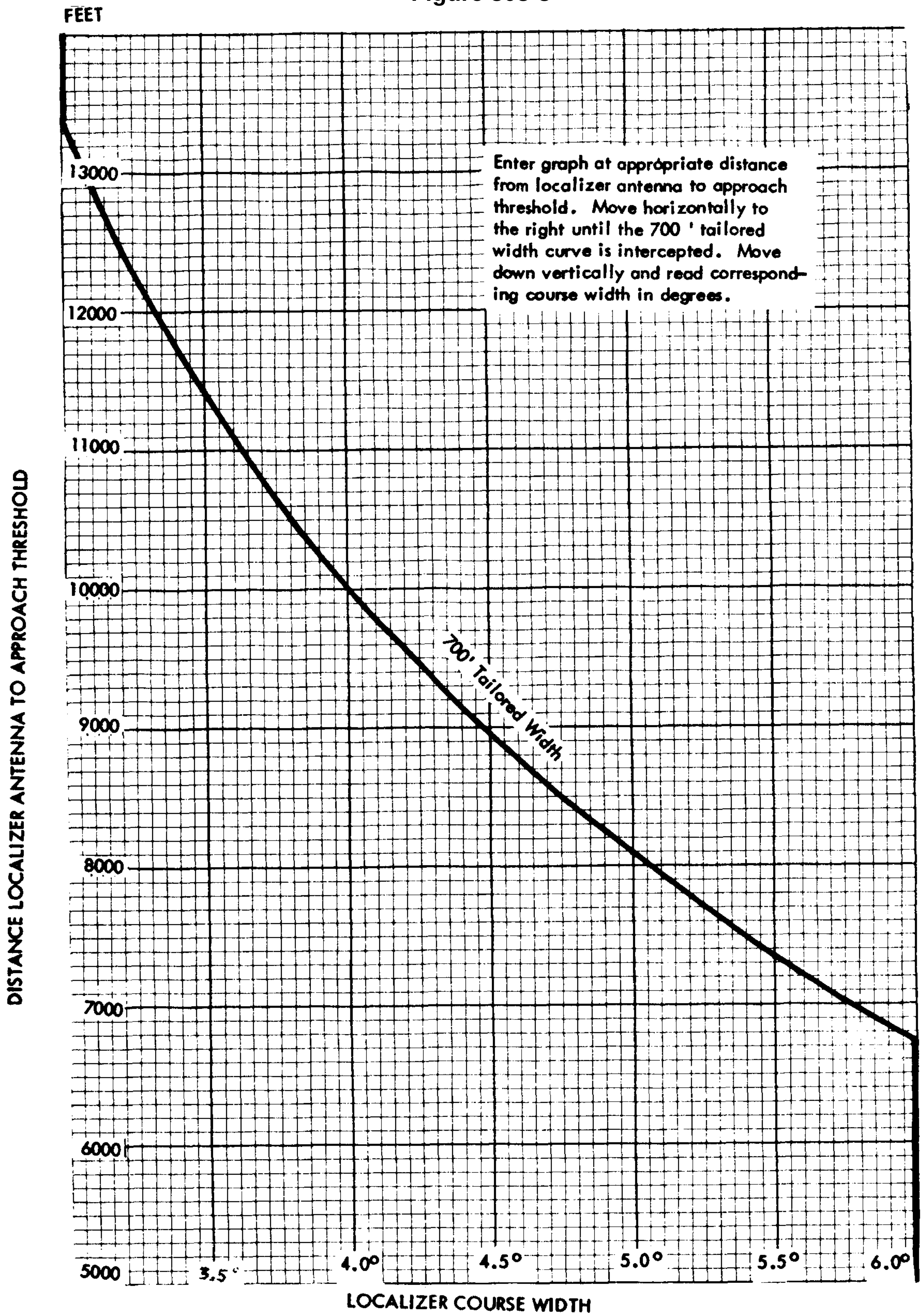


Figure 303-2 CORRECTION FOR EARTH CURVATURE

TAILORED LOCALIZER COURSE WIDTH
Figure 303-3



ILS STRUCTURE TOLERANCES
Figure 303-4A

LOCALIZER

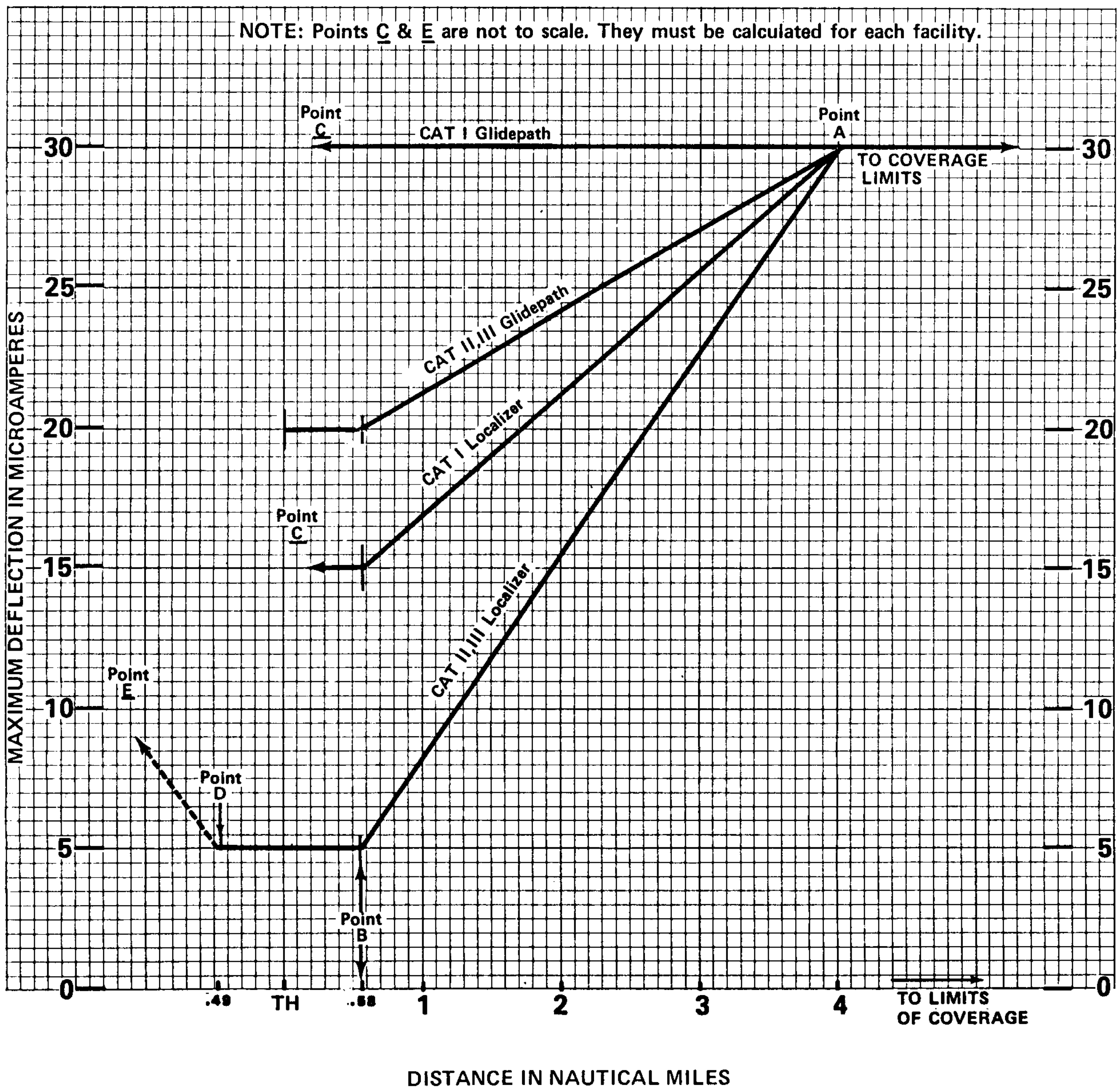
CAT I – Coverage Limits to PtA = 30 uA
Pt. A to Pt. B = 15 uA + (D-0.58) 4.39
Pt. B to Pt. C = 15 uA

CAT II, III – Coverage Limits to Pt. A = 30 uA
Pt. A to Pt. B =5 uA + (D-0.58) 7.31
Pt. B to Pt. D =5 uA
Pt. D to Pt. E =5 uA+ $(\frac{t}{T} 5)$

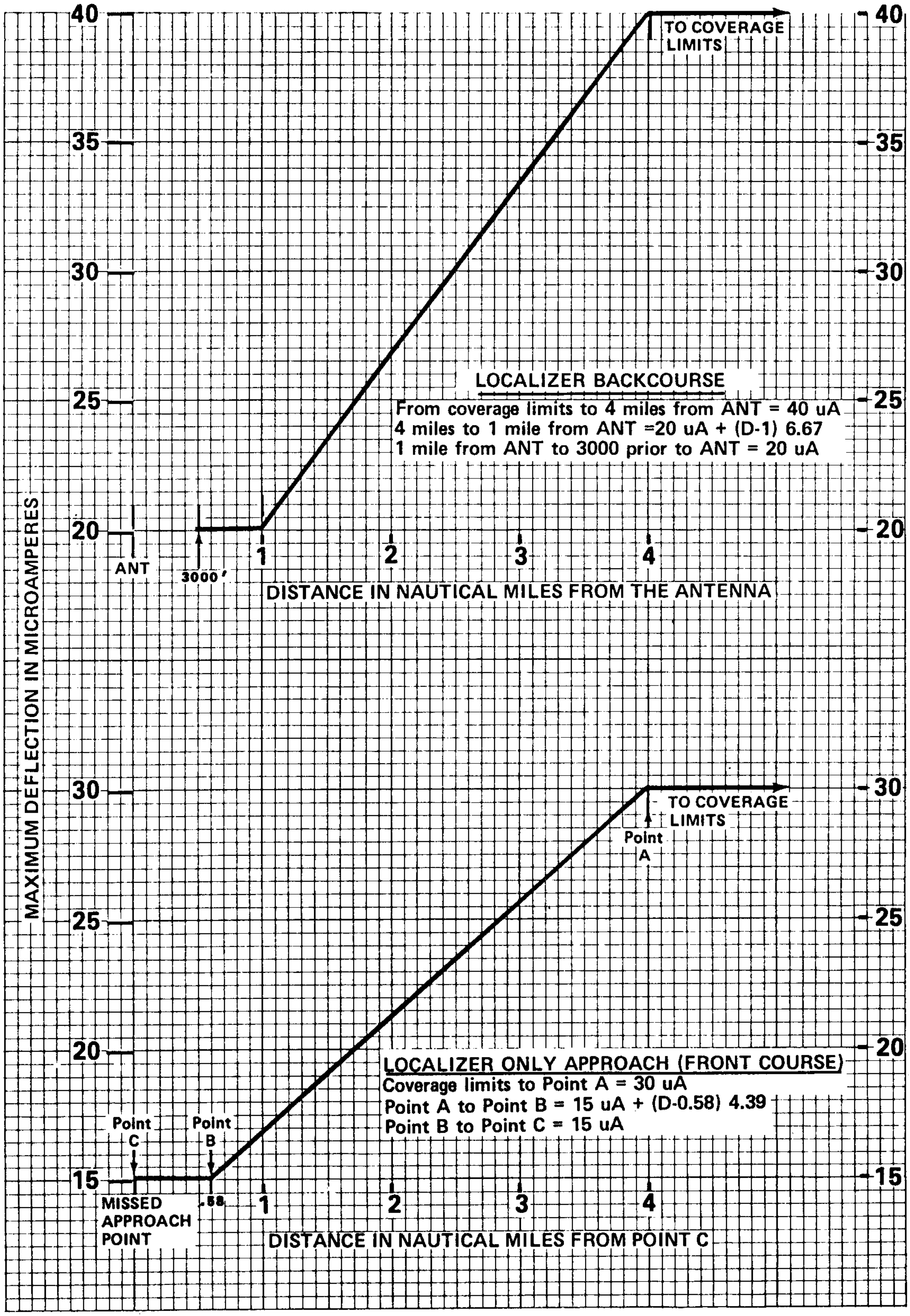
GLIDESLOPE

CAT I – Coverage Limits to Pt. C = 30 uA
CAT II, III – Coverage Limits to Pt. A = 30 uA
Pt. A to Pt. B = 20 uA + (D-0.58) 2.92
Pt. B to Threshold= 20 uA

D = Distance in nautical miles.
T = Distance in feet between Pt. D and Pt. E.
t = Distance in feet between Pt. D and the point at which the tolerance is being computed.



BACK COURSE AND LOCALIZER ONLY STRUCTURE TOLERANCES
Figure 303-4B



NAVAID Service Volumes. Most air navigation radio aids which provide positive course guidance have a designated standard service volume (SSV).

a. VOR/DME/TACAN Standard Service Volumes are illustrated in Figures 303-5A-F.

b. All elevations shown are with respect to the station's site elevation (AGL). Coverage is not available in a cone of airspace directly above the facility.

Figure 303-5A
Standard High Altitude Service Volume
(See Figure 303-5F for altitudes below 1,000 ft.)

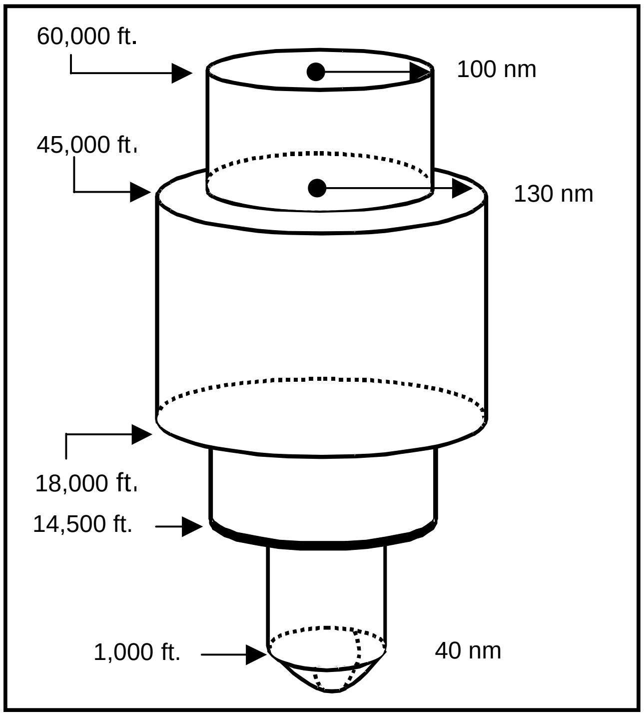


Figure 303-5B
Standard Low Altitude Service Volume
(See Figure 303-5F for altitudes below 1,000 ft.)

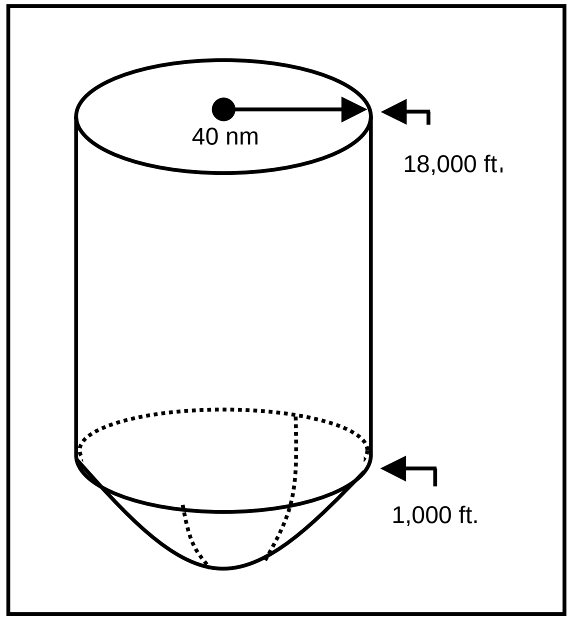


Figure 303-5C
Standard Terminal Service Volume
(See Figure 303-5E for altitudes below 1,000 ft.)

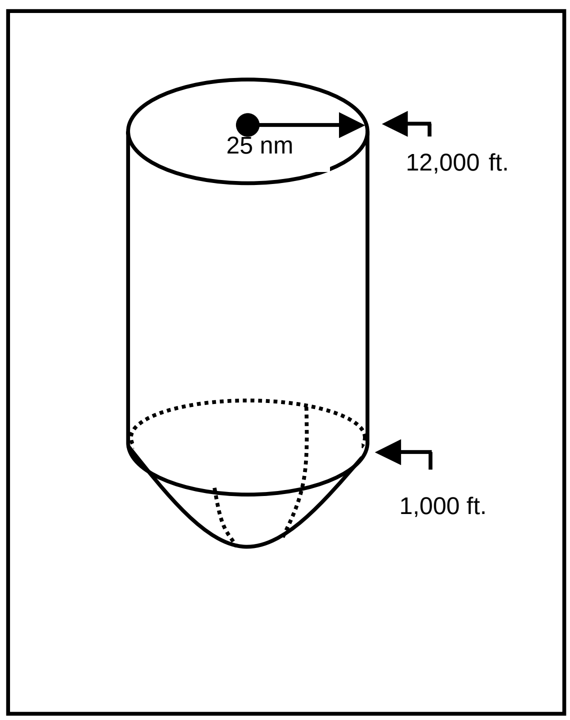


Figure 303-5D
VOR/DME/TACAN Standard Service Volume

SSV CLASS DESIGNATOR	***ALTITUDE AND RANGE BOUNDARIES***
T (Terminal) ……………………………….	From 1,000 ft above ground level (AGL) up to and including 12,000 ft AGL at radial distances out to 25 nm.
L (Low Altitude) …………………………	From 1,000 ft AGL up to and including 18,000 ft AGL at radial distances out to 40 nm.
H (High Altitude) ………………………..	From 1,000 ft AGL up to and including 14,500 ft AGL at radial distances out to 40 nm. From 14,500 ft AGL up to and including 60,000 ft at radial distances out to 100 nm. From 18,000 ft AGL up to and including 45,000 ft AGL at radial distances out to 130 nm.

Figure 303-5E
Service Volume Lower Edge Terminal

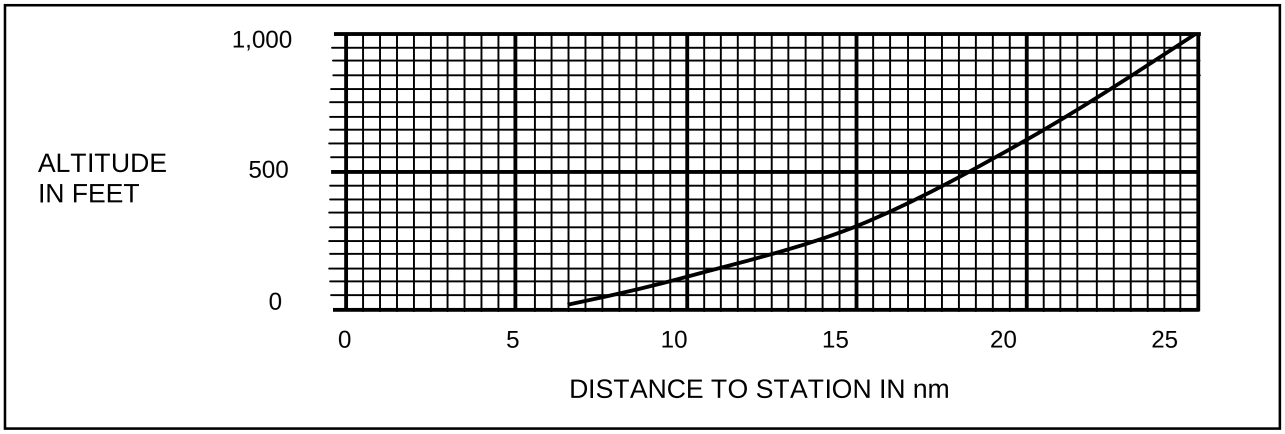


Figure 303-5F
Service Volume Lower Edge
Standard High and Low

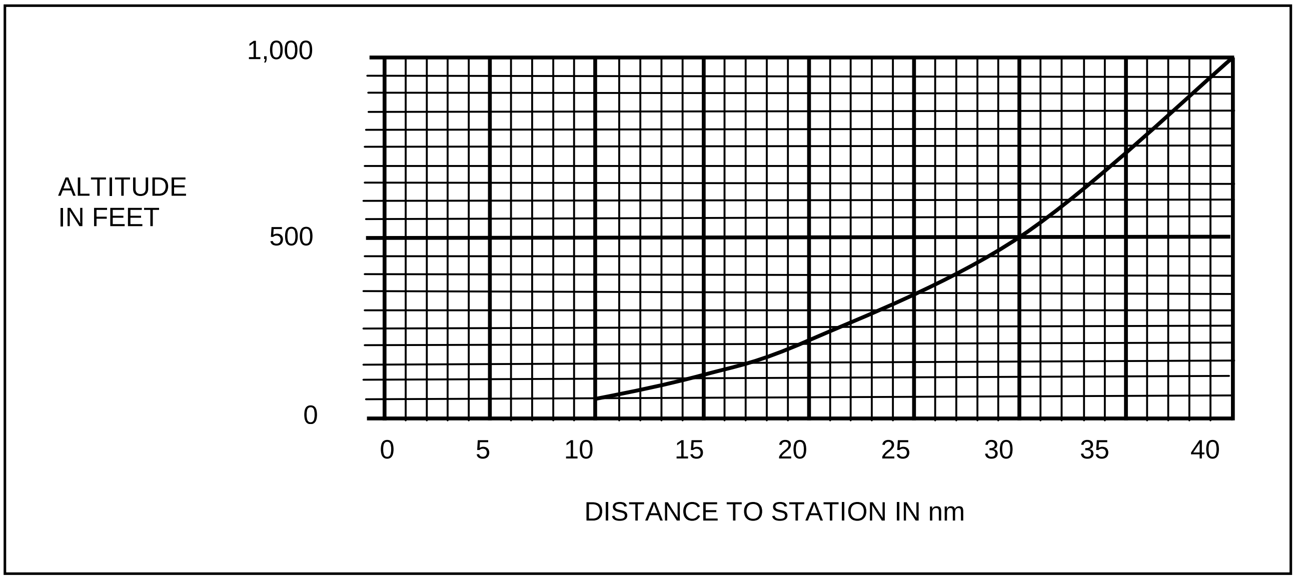


Figure 303-6A
VOR Sensing and Rotation

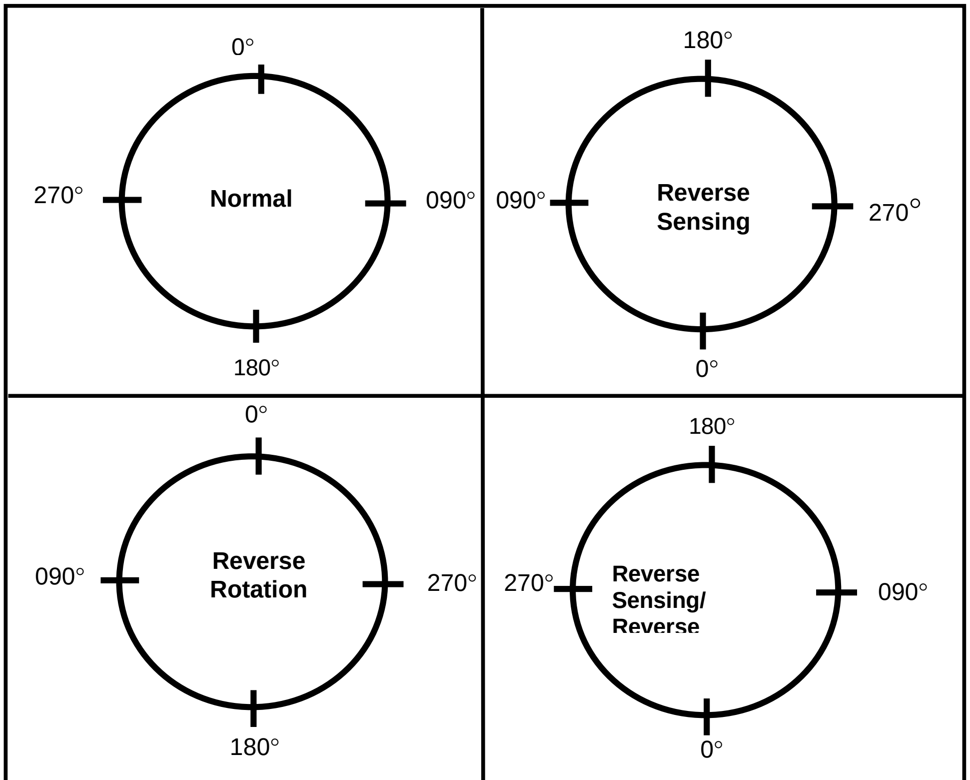


Figure 303-6B
TACAN Sensing and Rotation

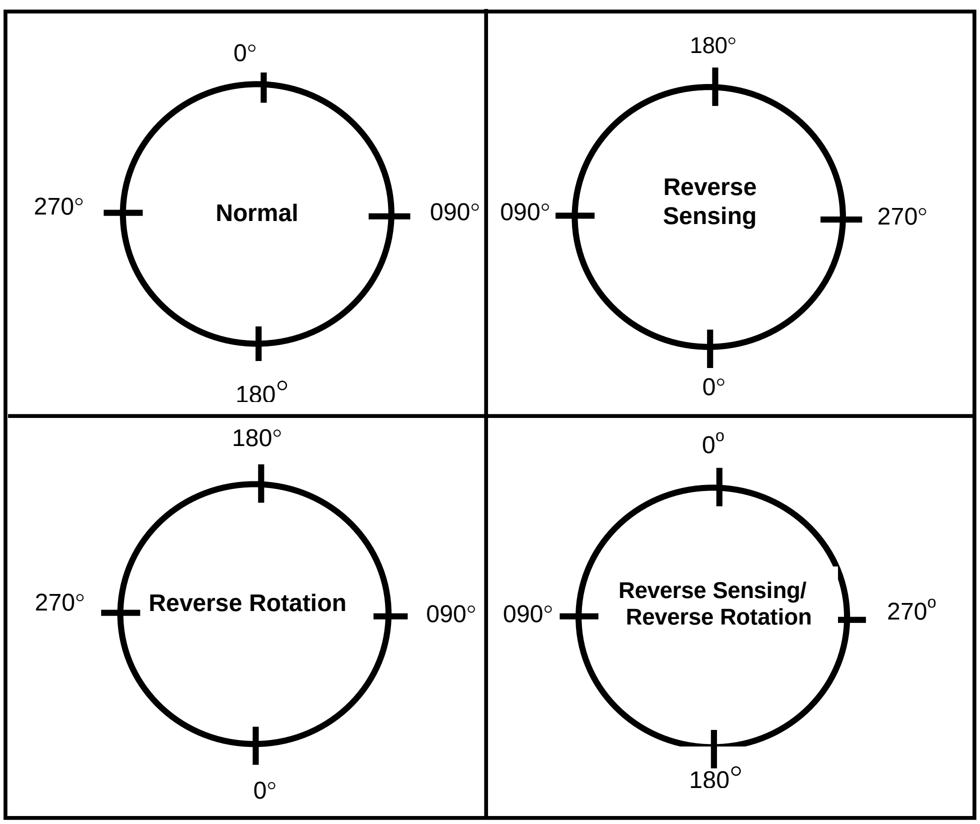


Figure 303-7

INTERSECTIONS (Coverage)			
Primary radials = 4 nm or 4.5°, whichever is greater		NDB's	Crossing Radial (not primary)
Dis. From fac in nm	Deg. Off course = to 4 nm		
5	38.7	± 5°	± 3.6°
6	33.7	± 5°	± 3.6°
7	29.7	± 5°	± 3.6°
8	26.6	± 5°	± 3.6°
9	24.0	± 5°	± 3.6°
10	21.8	± 5°	± 3.6°
11	20.0	± 5°	± 3.6°
12	18.4	± 5°	± 3.6°
13	17.1	± 5°	± 3.6°
14	15.9	± 5°	± 3.6°
15	14.9	± 5°	± 3.6°
16	14.0	± 5°	± 3.6°
17	13.2	± 5°	± 3.6°
18	12.5	± 5°	± 3.6°
19	11.9	± 5°	± 3.6°
20	11.3	± 5°	± 3.6°
21	10.8	± 5°	± 3.6°
22	10.3	± 5°	± 3.6°
23	9.9	± 5°	± 3.6°
24	9.5	± 5°	± 3.6°
25	9.1	± 5°	± 3.6°
26	8.7	± 5°	± 3.6°
27	8.4	± 5°	± 3.6°
28	8.1	± 5°	± 3.6°
29	7.9	± 5°	± 3.6°
30	7.6	± 5°	± 3.6°
31	7.4	± 5°	± 3.6°
32	7.1	± 5°	± 3.6°
33	6.9	± 5°	± 3.6°
34	6.7	± 5°	± 3.6°
35	6.5	± 5°	± 3.6°
36	6.3	± 5°	± 3.6°
37	6.2	± 5°	± 3.6°
38	6.0	± 5°	± 3.6°
39	5.9	± 5°	± 3.6°
40	5.7	± 5°	± 3.6°
41	5.6	± 5°	± 3.6°
42	5.4	± 5°	± 3.6°
43	5.3	± 5°	± 3.6°
44	5.2	± 5°	± 3.6°
45	5.1	± 5°	± 3.6°
46	5.0	± 5°	± 3.6°
47	4.9	± 5°	± 3.6°
48	4.8	± 5°	± 3.6°
49	4.7	± 5°	± 3.6°
50.8	4.5	± 5°	± 3.6°

Dis. from fac in nm	nm distance = 4.5°	NDB'S	Crossing Radial (not primary)
52	4.09	± 5°	± 3.6°
53	4.17	± 5°	± 3.6°
54	4.25	± 5°	± 3.6°
55	4.33	± 5°	± 3.6°
56	4.41	± 5°	± 3.6°
57	4.49	± 5°	± 3.6°
58	4.56	± 5°	± 3.6°
59	4.64	± 5°	± 3.6°
60	4.72	± 5°	± 3.6°
61	4.80	± 5°	± 3.6°
62	4.88	± 5°	± 3.6°
63	4.96	± 5°	± 3.6°
64	5.04	± 5°	± 3.6°
65	5.12	± 5°	± 3.6°
66	5.19	± 5°	± 3.6°
67	5.27	± 5°	± 3.6°
68	5.35	± 5°	± 3.6°
69	5.43	± 5°	± 3.6°
70	5.51	± 5°	± 3.6°
71	5.59	± 5°	± 3.6°
72	5.67	± 5°	± 3.6°
73	5.75	± 5°	± 3.6°
74	5.82	± 5°	± 3.6°
75	5.90	± 5°	± 3.6°
76	5.98	± 5°	± 3.6°
77	6.06	± 5°	± 3.6°
78	6.14	± 5°	± 3.6°
79	6.22	± 5°	± 3.6°
80	6.30	± 5°	± 3.6°
81	6.37	± 5°	± 3.6°
82	6.45	± 5°	± 3.6°
83	6.53	± 5°	± 3.6°
84	6.61	± 5°	± 3.6°
85	6.69	± 5°	± 3.6°
86	6.77	± 5°	± 3.6°
87	6.85	± 5°	± 3.6°
88	6.93	± 5°	± 3.6°
89	7.00	± 5°	± 3.6°
90	7.08	± 5°	± 3.6°
91	7.16	± 5°	± 3.6°
92	7.24	± 5°	± 3.6°
93	7.32	± 5°	± 3.6°
94	7.40	± 5°	± 3.6°
95	7.48	± 5°	± 3.6°
96	7.56	± 5°	± 3.6°
97	7.63	± 5°	± 3.6°
98	7.71	± 5°	± 3.6°

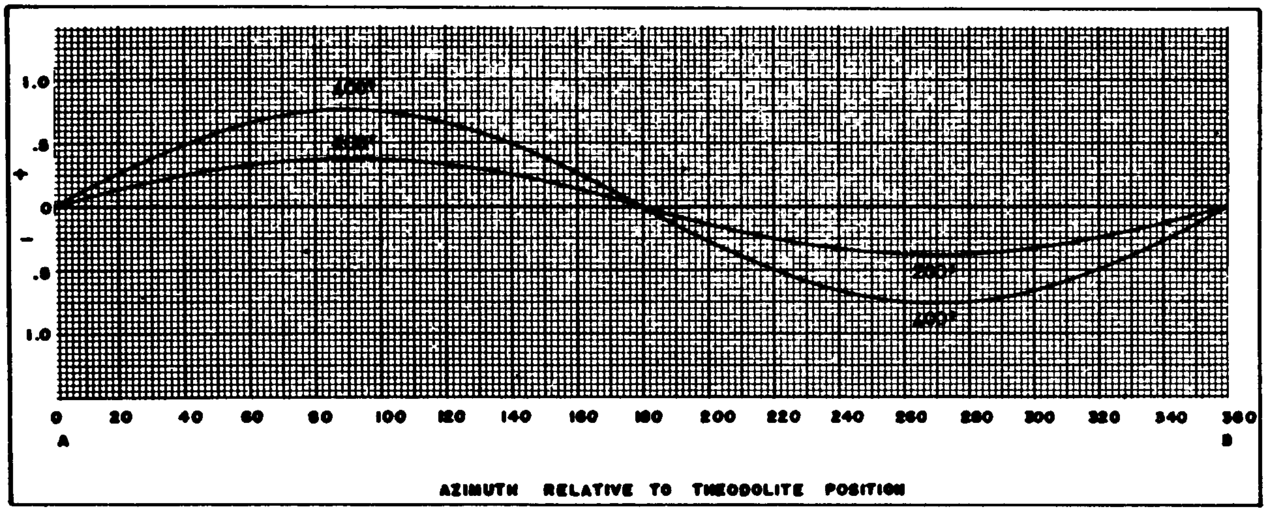
Dis. from fac in nm	nm distance = 4.5°	NDB'S	Crossing Radial (not primary)
99	7.79	± 5°	± 3.6°
100	7.87	± 5°	± 3.6°
101	7.95	± 5°	± 3.6°
102	8.03	± 5°	± 3.6°
103	8.11	± 5°	± 3.6°
104	8.18	± 5°	± 3.6°
105	8.26	± 5°	± 3.6°
106	8.34	± 5°	± 3.6°
107	8.42	± 5°	± 3.6°
108	8.50	± 5°	± 3.6°
109	8.58	± 5°	± 3.6°
110	8.66	± 5°	± 3.6°
111	8.74	± 5°	± 3.6°
112	8.81	± 5°	± 3.6°
113	8.89	± 5°	± 3.6°
114	8.97	± 5°	± 3.6°
115	9.05	± 5°	± 3.6°
116	9.13	± 5°	± 3.6°
117	9.21	± 5°	± 3.6°
118	9.29	± 5°	± 3.6°
119	9.37	± 5°	± 3.6°
120	9.44	± 5°	± 3.6°
121	9.52	± 5°	± 3.6°
122	9.60	± 5°	± 3.6°
123	9.68	± 5°	± 3.6°
124	9.76	± 5°	± 3.6°
125	9.84	± 5°	± 3.6°
126	9.92	± 5°	± 3.6°
127	10.00	± 5°	± 3.6°
128	10.07	± 5°	± 3.6°
129	10.15	± 5°	± 3.6°
130	10.23	± 5°	± 3.6°
131	10.31	± 5°	± 3.6°
132	10.39	± 5°	± 3.6°
133	10.47	± 5°	± 3.6°
134	10.55	± 5°	± 3.6°
135	10.62	± 5°	± 3.6°
136	10.70	± 5°	± 3.6°
137	10.78	± 5°	± 3.6°
138	10.86	± 5°	± 3.6°
139	10.94	± 5°	± 3.6°
140	11.02	± 5°	± 3.6°
141	11.10	± 5°	± 3.6°
142	11.18	± 5°	± 3.6°
143	11.25	± 5°	± 3.6°
144	11.33	± 5°	± 3.6°
145	11.41	± 5°	± 3.6°

Dis. from fac in nm	nm distance = 4.5°	NDB'S	Crossing Radial (not primary)
146	11.49	± 5°	± 3.6°
147	11.57	± 5°	± 3.6°
148	11.65	± 5°	± 3.6°
149	11.73	± 5°	± 3.6°
150	11.81	± 5°	± 3.6°
151	11.88	± 5°	± 3.6°
152	11.96	± 5°	± 3.6°
153	12.04	± 5°	± 3.6°
154	12.12	± 5°	± 3.6°
155	12.20	± 5°	± 3.6°
156	12.28	± 5°	± 3.6°
157	12.36	± 5°	± 3.6°
158	12.43	± 5°	± 3.6°
159	12.51	± 5°	± 3.6°
160	12.59	± 5°	± 3.6°
161	12.67	± 5°	± 3.6°
162	12.75	± 5°	± 3.6°
163	12.83	± 5°	± 3.6°
164	12.91	± 5°	± 3.6°
165	12.99	± 5°	± 3.6°
166	13.06	± 5°	± 3.6°
167	13.14	± 5°	± 3.6°
168	13.22	± 5°	± 3.6°
169	13.30	± 5°	± 3.6°
170	13.38	± 5°	± 3.6°
171	13.46	± 5°	± 3.6°
172	13.54	± 5°	± 3.6°
173	13.62	± 5°	± 3.6°
174	13.69	± 5°	± 3.6°
175	13.77	± 5°	± 3.6°
176	13.85	± 5°	± 3.6°
177	13.93	± 5°	± 3.6°
178	14.01	± 5°	± 3.6°
179	14.09	± 5°	± 3.6°
180	14.17	± 5°	± 3.6°
181	14.25	± 5°	± 3.6°
182	14.32	± 5°	± 3.6°
183	14.40	± 5°	± 3.6°
184	14.48	± 5°	± 3.6°
185	14.56	± 5°	± 3.6°
186	14.64	± 5°	± 3.6°
187	14.72	± 5°	± 3.6°
188	14.80	± 5°	± 3.6°
189	14.87	± 5°	± 3.6°
190	14.95	± 5°	± 3.6°

Dis. from fac in nm	nm distance = 4.5°	NDB'S	Crossing Radial (not primary)
191	15.03	± 5°	± 3.6°
192	15.11	± 5°	± 3.6°
193	15.19	± 5°	± 3.6°
194	15.27	± 5°	± 3.6°
195	15.35	± 5°	± 3.6°
196	15.43	± 5°	± 3.6°
197	15.50	± 5°	± 3.6°
198	15.58	± 5°	± 3.6°
199	15.66	± 5°	± 3.6°
200	15.74	± 5°	± 3.6°

SECTION 304. THEODOLITE ERROR

APARENT ERROR CAUSED BY THEODOLITE POSITION
Figure 304



Five-mile Orbit. For 10-mile Orbit, use 1/2 the indicated error. Distance of theodolite from antenna: 200 ft. -- 400 ft. as marked. Azimuth may be read directly when theodolite is North of station (0^0). For other positions, enter the actual azimuth of the theodolite at Point A, and continue in sequence through 360^0 to Point B.

SECTION 305. FREQUENCY SPECTRUM

TABLE OF CONTENTS

SECTION 305. FREQUENCY SPECTRUM

305.1 Frequency Allocation.

The following is a tabulation of frequencies available for use in the aeronautical, broadcast, and mobile bands. This tabulation may be used as an aid for identifying potential sources of interference. Also included is the VHF/UHF NAVAID Frequency Channeling and Pairing Chart which covers the X and Y channels for TACAN, 50 kHz spacing for VOR and LOC, and 150 kHz GS spacing. The Frequency Management Office can provide additional information regarding users of specific frequencies or bands of frequencies.

Frequency	Service
200-415 kHz	L/MF radio beacons, ranges, and tower voice (285-325 kHz and 405-415 kHz shared with maritime navigational aids).
1605 kHz-24 mHz	MF/HF Communications (shared with all services and Goverment/non-Goverment users).
90 -110 kHz	Loran-C
75m Hz	VHF Marker Beacons
108-118 mHz	ILS Localizer & VOR
118-136 mHz	VHF Communications
162-174 mHz	Relay/Control of VORTAC
225-328.6 mHz	UHFCommunications
328.6-335.4 mHz	ILS Glide Slope
335.4-400 mHz	UHF Communications
406-420 mHz	Relay/Control of VORTAC
420-460 mHz	Radio Altimeter
960-1215 mHz	TACAN and DME
1030 mHz and 1090 mHz	ATC Radar Beacon
1215-1400 mHz	Long Range Surveillance Radar
1227.6 mHz	L2 GPS
1435-1535 mHz	Aeronautical Telemetering (Flight Tests)
1535-1542.5 mHz	Maritime Mobile-Satellite
1542.5-1543.5 mHz	Aeronautical Mobile-Satellite (R) and Maritime Mobile-Satellite

Frequency	Service
1543.5-1558.5 mHz	Aeronautical Mobile-Satellite (R)
1558.5-1636.5 mHz	Aeronautical Radio Navigation
1575.42mHz	L2 Global Positioning System
1636.5-1644 mHz	Maritime Mobile-Satellite
1644-1645 mHz	Aeronautical Mobile-Satellite (R) and Maritime Mobile Satellite
1645-1660 mHz	Aeronautical Mobile Satellite (R)
2700-2900 mHz	Airport Surveillance Radar (shared with meteorological radar).
4200-4400 mHz	Radar Altimeter
5000-5250 mHz	Reserved for Aeronautical Radio Navigation and Space Radio Communication
5031 –5090.7 MHz (MLS)	Microwave Landing System
5350-5470 mHz	Airborne Weather Radar
7125-8400 mHz	Microwave Link for Long Range Radar Relay
8800 mHz	Airborne Doppler Radar
9000-9200 mHz	Precision Approach Radar (PAR)
9300-9500 mHz	Airborne Weather Radar
13.25-13.4 gHz	Doppler Navigation Aids
15.4-15.7 gHz	Reserved for Aeronautical Radio Navigation and Space Radio Communications
24.25-24.47 gHz	Airport Surface Detect Radar (ASDE)

Frequency	Broadcast
540-1600 kHz	Standard USA
2300-2495 kHz	Tropical Zone only
2500 kHz	WWV Standard Frequency
3200-3400 kHz	Tropical Zone only
3900-4000 kHz	International (Region 3 only)
3950-4000 kHz	International (Region 1 only)
4750-4995 kHz	Tropical Zone only
5000 kHz	WWV Standard Frequency
5005-5060 kHz	Tropical Zone only
5950-6200 kHz	International
9500-9775 kHz	International
10 mHz	WWV Standard Frequency
11.7-11.975 mHz	International
15 mHz	WWV Standard Frequency
15.1-15.45 mHz	International
17.7-17.9 mHz	International
20 mHz	WWV Standard Frequency
21.45-21.75 mHz	International
25 mHz	WWV Standard Frequency
25.6-26.1 mHz	International
54-72 mHz	Television, VHF
76-88 mHz	Television, VHF
88-108 mHz	FM
174-216 mHz	Television, VHF
470-890 mHz	Television, UHF

305.2 NOMENCLATURE OF FREQUENCY BANDS

305.21 International

VLF —Very Low Frequency—0-30 kHz

LF —Low Frequency—30-300 kHz

MF —Medium Frequency—300-3,000 kHz

HF —High Frequency—3,000-30,000 kHz

VHF—Very High Frequency—30,000 kHz-300 mHz

UHF—Ultra High Frequency—300-3,000 mHz

SHF—Super High Frequency—3,000-30,000 mHz

EHF—Extremely High Frequency—30,000-300,000 mHz

The shaded frequencies are, for AFIS use, paired communications frequencies that correspond to the indicated TACAN channel.

305.22 VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING

						DME AIRBORNE INTERROGATE				DME GND REPLY	
						PULSE CODE					
							NORMAL	P/DME			
DME CHN NO.	FREQUENCY LOC	GS	VHF/ VOR	MLS	MLS CHN NO.	FREQ	DME us	IA us	FA us	DME FREQ	PC us
1X	-	-	134.40	-	-	1025	12	--	--	962	12
1Y	-	-	134.45	-	-	1025	36	--	--	1088	30
2X	-	-	134.50	-	-	1026	12	--	--	963	12
2Y	-	-	134.55	-	-	1026	36	--	--	1089	30
3X	-	-	134.60	-	-	1027	12	--	--	964	12
3Y	-	-	134.65	-	-	1027	36	--	--	1090	30
4X	-	-	134.70	-	-	1028	12	--	--	965	12
4Y	-	-	134.75	-	-	1028	36	--	--	1091	30
5X	-	-	134.80	-	-	1029	12	--	--	966	12
5Y	-	-	134.85	-	-	1029	36	-	-	1092	30
6X	-	-	134.90	-	-	1030	12	-	-	967	12
6Y	-	-	134.95	-	-	1030	36	-	-	1093	30
7X	-	-	135.00	-	-	1031	12	-	-	968	12
7Y	-	-	135.05	-	-	1031	36	-	-	1094	30
8X	-	-	135.10	-	-	1032	12	-	-	969	12
8Y	-	-	135.15	-	-	1032	36	-	-	1095	30
9X	-	-	135.20	-	-	1033	12	-	-	970	12
9Y	-	-	135.25	-	-	1033	36	-	-	1096	30
10X	-	-	135.30	-	-	1034	12	-	-	971	12
10Y	-	-	135.35	-	-	1034	36	-	-	1097	30
11X	-	-	135.40	-	-	1035	12	-	-	972	12
11Y	-	-	135.45	-	-	1035	36	-	-	1098	30
12X	-	-	135.50	-	-	1036	12	-	-	973	12
12Y	-	-	135.55	-	-	1036	36	-	-	1099	30
13X	-	-	135.60	-	-	1037	12	-	-	974	12
13Y	-	-	135.65	-	-	1037	36	-	-	1100	30
14X	-	-	135.70	-	-	1038	12	-	-	975	12
14Y	-	-	135.75	-	-	1038	36	-	-	1101	30
15X	-	-	135.80	-	-	1039	12	-	-	976	12
15Y	-	-	135.85	-	-	1039	36	-	-	1102	30
16X	-	-	135.90	-	-	1040	12	-	-	977	12
16Y	-	-	135.95	-	-	1040	36	-	-	1103	30
17X	-	-	108.00	-	-	1041	12	-	-	978	12
17Y	-	-	108.05	5043.0	540	1041	36	36	42	1104	30
18X	108.10	334.70		5031.0	500	1042	12	12	18	979	12
18Y	108.15	334.55		5043.6	542	1042	36	36	42	1105	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHN NO.	FREQUENCY LOC	FREQUENCY GS	FREQUENCY VHF/VOR	FREQUENCY MLS	MLS CHN NO.	FREQ	DME AIRBORNE INTERROGATE PULSE CODE NORMAL DME us	DME AIRBORNE INTERROGATE PULSE CODE P/DME IA us	DME AIRBORNE INTERROGATE PULSE CODE P/DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
19X	-	-	108.20	-	-	1043	12	-	-	980	12
19Y	-	-	108.25	-	-	1043	36	36	42	1106	30
20X	108.30	334.10		5031.6	502	1044	12	12	18	981	12
20Y	108.35	333.95		5044.8	546	1044	36	36	42	1107	30
21X	-	-	108.40	-	-	1045	12	-	-	982	12
21Y	-	-	108.45	5045.4	548	1045	36	36	42	1108	30
22X	108.50	329.90		5032.2	504	1046	12	12	18	983	12
22Y	108.55	329.75		5046.0	550	1046	36	36	42	1109	30
23X	-	-	108.60	-	-	1047	12	-	-	984	12
23Y	-	-	108.65	5046.6	552	1047	36	36	42	1110	30
24X	108.70	330.50		5032.8	506	1048	12	12	18	985	12
24Y	108.75	330.35		5047.2	554	1048	36	36	42	1111	30
25X	-	-	108.80	-	-	1049	12	-	-	986	12
25Y	-	-	108.85	5047.8	556	1049	36	36	42	1112	30
26X	108.90	329.30		5033.4	508	1050	12	12	18	987	12
26Y	108.95	329.15		5048.4	558	1050	36	36	42	1113	30
27X	-	-	109.00	-	-	1051	12	-	-	988	12
27Y	-	-	109.05	5049.0	560	1051	36	36	42	1114	30
28X	109.10	331.40		5034.0	510	1052	12	12	18	989	12
28Y	109.15	331.25		5049.6	562	1052	36	36	42	1115	30
29X	-	-	109.20	-	-	1053	12	-	-	990	12
29Y	-	-	109.25	5050.2	564	1053	36	36	42	1116	30
30X	109.30	332.00		5034.6	512	1054	12	12	18	991	12
30Y	109.35	331.85		5050.8	556	1054	36	36	42	1117	30
31X	-	-	109.40	-	-	1055	12	-	-	992	12
31Y	-	-	109.45	5051.4	568	1055	36	36	42	1118	30
32X	109.50	332.60		5035.2	514	1056	12	12	18	993	12
32Y	109.55	332.45		5052.0	570	1056	36	36	42	1119	30
33X	-	-	109.60	-	-	1057	12	-	-	994	12
33Y	-	-	109.65	5052.6	572	1057	36	36	42	1120	30
34X	109.70	333.20	-	5035.8	516	1058	12	12	18	995	12
34Y	109.75	333.05	-	5035.2	574	1058	36	36	42	1121	30
35X	-	-	109.80	-	-	1059	12	-	-	996	12
35Y	-	-	109.85	5053.8	576	1059	36	36	42	1122	30
36X	109.90	333.80		5036.4	518	1060	12	12	18	997	12
36Y	109.95	333.65		5054.4	578	1060	36	36	42	1123	30
37X	-	-	110.00	-	-	1061	12	-	-	998	12
37Y	-	-	110.05	5055.0	580	1061	36	36	42	1124	30
38X	110.10	334.40		5037.0	520	1062	12	12	18	999	12
38Y	110.15	334.25									
39X	-	-	110.20	-	-	1063	12	-	-	1000	12
39Y	-	-	110.25	5056.2	584	1063	36	36	42	1126	30
40X	110.30	335.00		5037.6	522	1064	12	12	18	1001	12
40Y	110.35	334.85		5056.8	586	1064	36	36	42	1127	30
41X	-	-	110.40	-	-	1065	12	-	-	1002	12
41Y	-	-	110.45	5057.4	588	1065	36	36	42	1128	30
42X	110.50	329.60		5038.2	524	1066	12	12	18	1003	12
42Y	110.55	329.45		5058.0	590	1066	36	36	42	1129	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHN NO.	FREQUENCY LOC	FREQUENCY GS	FREQUENCY VHF/VOR	FREQUENCY MLS	MLS CHN NO.	DME AIRBORNE INTERROGATE FREQ	PULSE CODE NORMAL DME us	PULSE CODE P/DME IA us	PULSE CODE P/DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
43X	-	-	110.60	-	-	1067	12	-	-	1004	12
43Y	-	-	110.65	5058.6	592	1067	36	36	42	1130	30
44X	110.70	330.20		5038.8	526	1068	12	12	18	1005	12
44Y	110.75	330.05		5059.2	594	1068	36	36	42	1131	30
45X	-	-	110.80	-	-	1069	12	-	-	1006	12
45Y	-	-	110.85	5059.8	596	1069	36	36	42	1132	30
46X	110.90	330.80		5039.4	528	1070	12	12	18	1007	12
46Y	110.95	330.65		5060.4	598	1070	36	36	42	1133	30
47X	-	-	111.00	-	-	1071	12	-	-	1008	12
47Y	-	-	111.05	5061.0	600	1071	36	36	42	1134	30
48X	111.10	331.70		5040.0	530	1072	12	12	18	1009	12
48Y	111.15	331.55		5061.6	602	1072	36	36	42	1135	30
49X	-	-	111.20	-	-	1073	12	-	-	1010	12
49Y	-	-	111.25	6062.2	604	1073	36	36	42	1136	30
50X	111.30	332.30		5040.6	532	1074	12	12	18	1011	12
50Y	111.35	332.15		5062.8	606	1074	36	36	42	1137	30
51X	-	-	111.40	-	-	1075	12	-	-	1012	12
51Y	-	-	111.45	5063.4	608	1075	36	36	42	1136	30
52X	111.50	332.90		5041.2	534	1076	12	12	18	1013	12
52Y	111.55	332.75		5064.0	610	1076	36	36	42	1139	30
53X	-	-	111.60	-	-	1077	12	-	-	1014	12
53Y	-	-	111.65	5064.4	612	1077	36	36	42	1140	30
54X	111.70	333.50		5041.8	536	1078	12	12	18	1015	12
54Y	111.75	333.35		5065.2	614	1078	36	36	42	1141	30
55X	-	-	111.80	-	-	1079	12	-	-	1016	12
55Y	-	-	111.85	5065.8	616	1079	36	36	42	1142	30
56X	111.90	331.10		5042.4	538	1080	12	12	18	1017	12
56Y	111.95	330.95		5066.4	618	1080	36	36	42	1143	30
57X	-	-	112.00	-	-	1081	12	-	-	1018	12
57Y	-	-	112.05	-	-	1081	36	-	-	1144	30
58X	-	-	112.10	-	-	1082	12	-	-	1019	12
58Y	-	-	112.15	-	-	1082	36	-	-	1145	30
59X	-	-	112.20	-	-	1083	12	-	-	1020	12
59Y	-	-	112.25	-	-	1083	36	-	-	1146	30
60X	-	-	133.30	-	-	1084	12	-	-	1021	12
60Y	-	-	133.35	-	-	1084	36	-	-	1147	30
61X	-	-	133.40	-	-	1085	12	-	-	1022	12
61Y	-	-	133.45	-	-	1085	36	-	-	1148	30
62X	-	-	133.50	-	-	1086	12	-	-	1023	12
62Y	-	-	133.55	-	-	1086	36	-	-	1149	30
63X	-	-	133.60	-	-	1087	12	-	-	1024	12
63Y	-	-	133.65	-	-	1087	36	-	-	1150	30
64X	-	-	133.70	-	-	1088	12	-	-	1151	12
64Y	-	-	133.75	-	-	1088	36	-	-	1025	30
65X	-	-	133.80	-	-	1089	12	-	-	1152	12
65Y	-	-	133.85	-	-	1089	36	-	-	1026	30
66X	-	-	133.90	-	-	1090	12	-	-	1153	12
66Y	-	-	133.95	-	-	1090	36	-	-	1027	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHN NO.	FREQUENCY LOC	FREQUENCY GS	FREQUENCY VHF/ VOR	FREQUENCY MLS	MLS CHN NO.	DME AIRBORNE INTERROGATE FREQ	PULSE CODE NORMAL DME us	PULSE CODE P/DME IA us	PULSE CODE P/DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
67X	-	-	134.00	-	-	1091	12	-	-	1154	12
67Y	-	-	134.05	-	-	1091	36	-	-	1028	30
68X	-	-	134.10	-	-	1092	12	-	-	1155	12
68Y	-	-	134.15	-	-	1092	36	-	-	1029	30
69X	-	-	134.20	-	-	1093	12	-	-	1156	12
69Y	-	-	134.25	-	-	1093	36	-	-	1030	30
70X	-	-	112.30	-	-	1094	12	-	-	1157	12
70Y	-	-	112.35	-	-	1094	36	-	-	1031	30
71X	-	-	112.40	-	-	1095	12	-	-	1158	12
71Y	-	-	112.45	-	-	1095	36	-	-	1032	30
72X	-	-	112.50	-	-	1096	12	-	-	1159	12
72Y	-	-	112.55	-	-	1096	36	-	-	1033	30
73X	-	-	112.60	-	-	1097	12	-	-	1160	12
73Y	-	-	112.65	-	-	1097	36	-	-	1034	30
74X	-	-	112.70	-	-	1098	12	-	-	1161	12
74Y	-	-	112.75	-	-	1098	36	-	-	1035	30
75X	-	-	112.80	-	-	1099	12	-	-	1162	12
75Y	-	-	112.85	-	-	1099	36	-	-	1036	30
76X	-	-	112.90	-	-	1100	12	-	-	1163	12
76Y	-	-	112.95	-	-	1100	36	-	-	1037	30
77X	-	-	113.00	-	-	1101	12	-	-	1164	12
77Y	-	-	113.05	-	-	1101	36	-	-	1038	30
78X	-	-	113.10	-	-	1102	12	-	-	1165	12
78Y	-	-	113.15	-	-	1102	36	-	-	1039	30
79X	-	-	113.20	-	-	1103	12	-	-	1166	12
79Y	-	-	113.25	-	-	1103	36	-	-	1040	30
80X	-	-	113.30	-	-	1104	12	-	-	1167	12
80Y	-	-	113.35	5067.0	620	1104	36	36	42	1041	30
81X	-	-	113.40	-	-	1105	12	-	-	1168	12
81Y	-	-	113.45	5067.6	622	1105	36	36	42	1042	30
82X	-	-	113.50	-	-	1106	12	-	-	1169	12
82Y	-	-	113.55	5068.2	624	1106	36	36	42	1043	30
83X	-	-	113.60	-	-	1107	12	-	-	1170	12
83Y	-	-	113.65	5068.8	626	1107	36	36	42	1044	30
84X	-	-	113.70	-	-	1108	12	-	-	1171	12
84Y	-	-	113.75	5069.4	628	1108	36	36	42	1045	30
85X	-	-	113.80	-	-	1109	12	-	-	1172	12
85Y	-	-	113.85	5070.0	630	1109	36	36	42	1046	30
86X	-	-	113.90	-	-	1110	12	-	-	1173	12
86Y	-	-	113.95	5070.6	632	1110	36	36	42	1047	30
87X	-	-	114.00	-	-	1111	12	-	-	1174	12
87Y	-	-	114.05	5071.2	634	1111	36	36	42	1048	30
88X	-	-	114.10	-	-	1112	12	-	-	1175	12
88Y	-	-	114.15	5071.8	636	1112	36	36	42	1049	30
89X	-	-	114.20	-	-	1113	12	-	-	1176	12
89Y	-	-	114.25	5072.4	638	1113	36	36	42	1050	30
90X	-	-	114.30	-	-	1114	12	-	-	1177	12
90Y	-	-	114.35	5073.0	640	1114	36	36	42	1051	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

							DME AIRBORNE INTERROGATE			DME GND REPLY	
							PULSE CODE				
							NORMAL	P/DME			
DME CHN NO.	-------------FREQUENCY-------- LOC	GS	VHF/ VOR	MLS	MLS CHN NO.	FREQ	DME us	IA us	FA us	DME FREQ	PC us
91X	-	-	114.40	-	-	1115	12	-	-	1178	12
91Y	-	-	114.45	5073.6	642	1115	36	36	42	1052	30
92X	-	-	114.50	-	-	1116	12	-	-	1179	12
92Y	-	-	114.55	5074.2	644	1116	36	36	42	1053	30
93X	-	-	114.60	-	-	1117	12	-	-	1180	12
93Y	-	-	114.65	5074.8	646	1117	36	36	42	1054	30
94X	-	-	114.70	-	-	1118	12	-	-	1181	12
94Y	-	-	114.75	5075.4	648	1118	36	36	42	1055	30
95X	-	-	114.80	-	-	1119	12	-	-	1182	12
95Y	-	-	114.85	5076.0	650	1119	36	36	42	1056	30
96X	-	-	114.90	-	-	1120	12	-	-	1183	12
96Y	-	-	114.95	5076.6	652	1120	36	36	42	1057	30
97X	-	-	115.00	-	-	1121	12	-	-	1184	12
97Y	-	-	115.05	5077.2	654	1121	36	36	42	1058	30
98X	-	-	115.10	-	-	1122	12	-	-	1185	12
98Y	-	-	115.15	5077.8	656	1122	36	36	42	1059	30
99X	-	-	115.20	-	-	1123	12	-	-	1186	12
99Y	-	-	115.25	5078.4	658	1123	36	36	42	1060	30
100X	-	-	115.30	-	-	1124	12	-	-	1187	12
100Y	-	-	115.35	5079.0	660	1124	36	36	42	1061	30
101X	-	-	115.40	-	-	1125	12	-	-	1188	12
101Y	-	-	115.45	5079.6	662	1125	36	36	42	1062	30
102X	-	-	115.50	-	-	1126	12	-	-	1189	12
102Y	-	-	115.55	5050.2	664	1126	36	36	42	1063	30
103X	-	-	115.60	-	-	1127	12	-	-	1190	12
103Y	-	-	115.65	5080.8	666	1127	36	36	42	1064	30
104X	-	-	115.70	-	-	1128	12	-	-	1191	12
104Y	-	-	115.75	5081.4	668	1128	36	36	42	1065	30
105X	-	-	115.80	-	-	1129	12	-	-	1192	12
105Y	-	-	115.85	5082.0	670	1129	36	36	42	1066	30
106X	-	-	115.90	-	-	1130	12	-	-	1193	12
106Y	-	-	115.95	5082.6	672	1130	36	36	42	1067	30
107X	-	-	116.00	-	-	1131	12	-	-	1194	12
107Y	-	-	116.05	5083.2	674	1131	36	36	42	1068	30
108X	-	-	116.10	-	-	1132	12	-	-	1195	12
108Y	-	-	116.15	5083.8	676	1132	36	36	42	1069	30
109X	-	-	116.20	-	-	1133	12	-	-	1196	12
109Y	-	-	116.25	5084.4	678	1133	36	36	42	1070	30
110X	-	-	116.30	-	-	1134	12	-	-	1197	12
110Y	-	-	116.35	5085.0	680	1134	36	36	42	1071	30
111X	-	-	116.40	-	-	1135	12	-	-	1198	12
111Y	-	-	116.45	5085.6	682	1135	36	36	42	1072	30
112X	-	-	116.50	-	-	1136	12	-	-	1199	12
112Y	-	-	116.55	5086.2	684	1136	36	36	42	1073	30
113X	-	-	116.60	-	-	1137	12	-	-	1200	12
113Y	-	-	116.65	5086.8	686	1137	36	36	42	1074	30
114X	-	-	116.70	-	-	1138	12	-	-	1201	12
114Y	-	-	116.75	5087.4	688	1138	36	36	42	1075	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHN NO.	FREQUENCY LOC	FREQUENCY GS	FREQUENCY VHF/ VOR	FREQUENCY MLS	MLS CHN NO.	DME AIRBORNE INTERROGATE FREQ	PULSE CODE NORMAL DME us	PULSE CODE P/DME IA us	PULSE CODE P/DME FA us	DME GND REPLY DME FREQ	DME GND REPLY PC us
115X	-	-	116.80	-	-	1139	12	-	-	1202	12
115Y	-	-	116.85	5088.0	690	1139	36	36	42	1076	30
116X	-	-	116.90	-	-	1140	12	-	-	1203	12
116Y	-	-	116.95	5088.6	692	1140	36	36	42	1077	30
117X	-	-	117.00	-	-	1141	12	-	-	1204	12
117Y	-	-	117.05	5089.2	694	1141	36	36	42	1078	30
118X	-	-	117.10	-	-	1142	12	-	-	1205	12
118Y	-	-	117.15	5089.8	696	1142	36	36	42	1079	30
119X	-	-	117.20	-	-	1143	12	-	-	1206	12
119Y	-	-	117.25	5090.4	698	1143	36	36	42	1080	30
120X	-	-	117.30	-	-	1144	12	-	-	1207	12
120Y	-	-	117.35	-	-	1144	36	-	-	1081	30
121X	-	-	117.40	-	-	1145	12	-	-	1208	12
121Y	-	-	117.45	-	-	1145	36	-	-	1082	30
122X	-	-	117.50	-	-	1146	12	-	-	1209	12
122Y	-	-	117.55	-	-	1146	36	-	-	1083	30
123X	-	-	117.60	-	-	1147	12	-	-	1210	12
123Y	-	-	117.65	-	-	1147	36	-	-	1084	30
124X	-	-	117.70	-	-	1148	12	-	-	1211	12
124Y	-	-	117.75	-	-	1148	36	-	-	1085	30
125X	-	-	117.80	-	-	1149	12	-	-	1212	12
125Y	-	-	117.85	-	-	1149	36	-	-	1086	30
126X	-	-	117.90	-	-	1150	12	-	-	1213	12
126Y	-	-	117.95	-	-	1150	36	-	-	1087	30

SECTION 306. MAP INTERPRETATION

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SECTION 306. MAP INTERPRETATION

306.1 Introduction

a. Aeronautical charts normally used for checkpoint orbit checks have substantial effect on the data processing center. Through the cooperation of the United States Coast and Geodetic Survey, certain information concerning aeronautical charts has been collected. Coast and Geodetic Survey personnel have accompanied flight crews on orbit type checks. Outlined here is information considered helpful in improving the accuracy of flight inspection results, with particular reference to chart construction, design, and preparation for flight inspection use, checkpoint selection, etc.

b. The use of state highway maps or county maps is not recommended if aeronautical charts are available, as there is considerable variation in the accuracy of the maps among various states and counties.

c. It has been determined, however, that the **Defense Mapping Agency Series 1501, Joint Operations Graphics,** although not aeronautical charts, are satisfactory for flight inspection use. Due to the scale of these maps (1 to 250,000), greater detail is available than that displayed by the sectional charts; consequently more definable checkpoints can be utilized.

d. The positions of many facility sites have been determined by first-order triangulation or photogrammetric methods with a high degree of accuracy. Before recommending that coordinates of a facility be changed, the Coast and Geodetic Survey should be contacted for verification of such a change.

306.2 Aeronautical Chart Preparation

a. In congested areas of the Nation, checkpoints are plentiful, and it is possible to select only the most desirable. In sparsely settled areas, it may be necessary to use every feature appearing on the chart in order to obtain a maximum of 8 or 10 checkpoints. For these reasons, it is helpful to have an understanding of the manner in which final drawings for aeronautical charts are made.

b. The preparation of final drawings for charts using three separate colors is made as follows:

(1) Black. Includes railroads, roads (these are sketched in black, but photograph gray on final chart), city and town symbols, boundaries, dots showing the location of spot heights, landmark symbols, etc.

(2) Blue. Drainage.

(3) Brown. Contours.

c. The black is always drawn first and remaining colors are drawn only after the black has been verified and corrected.

d. In order to provide satisfactory clearances between various features, it is often necessary to shift some away from their correct geographic positions. This shift does not usually amount to more than 1/32 of an inch on the printed chart, but it is often required for increased clarity and legibility of the chart. In shifting, two general conditions are to be met:

(1) All possible detail in the relative position of the features is retained as closely as possible.

(2) The geographic position of the combination of features is retained as closely as possible.

e. For example, in case of a road paralleling a railroad for a short distance, the railroad is drawn in its true geographic position, and the road is displaced enough to provide the required clearance. If both were displaced by equal amounts, as first might be suspected, a curve that is nonexistent in fact would have to be introduced into the railroad or the railroad would have to be displaced for some little distance on either side, with consequent displacement of towns and other features along the railroad.

f. Similarly, if a road parallels the railroad for a short distance, then crosses and again parallels the railroad on the other side, the railroad should be shown in its correct position and the road displaced as before.

g. Further, there are conditions where a road may parallel a railroad for a short distance, and both may be displaced by an amount equal to one-half the required clearance.

h. In general, it has been found that a railroad should be held in its correct position first, a road second, and stream last. That is, between a railroad and a highway or stream, the latter are usually shifted; between a road and a stream, the stream is displaced.

i. If a stream flows between a road and a railroad, or between two railroads, *the stream retains its true position* and other features are displaced. As a rule, all town and city symbols are affixed in their correct positions. Since railroads and towns are usually held in their correct positions, other features are adjusted to them. Landmarks such as oil derricks, race-tracks, etc., should be used only as a last resort.

j. Since each color on a printed chart is a separate sheet, the registration of the colors may be checked at the "neat line" at each corner of the chart. The color which is not correct can be identified by the color tick. If a color is too far from correct registration, several charts should be examined and an effort made to obtain one that is more accurate.

306.3 Preparation of Charts for Flight Inspection Use. In preparing a chart for a flight inspection, the following procedure is outlined.

a. The *exact* latitude and longitude of the facility should be plotted on the chart as follows:

(1) Plot the longitude on parallels, which are subdivided into 1-minute intervals, north and south of the station, then draw a fine line connecting these two points and extend the line far enough in both directions to fit a large protractor. This will be the true north reference. The latitude should be scaled, using hairspring dividers, from the parallel below the site along the nearest meridian, subdivided into 1-minute - intervals, and then be transferred to the true north reference where it intersects the same parallel. Because of curvature in the parallels, this procedure will be far more accurate than measuring the latitude on each side of the site and then drawing a line between the two points of latitude.

(2) If two or more charts must be joined together, such as Kansas City and Des Moines for the St. Joseph VOR, it is suggested that the following method be used: Select one of the charts which will be used to plot the correct position of the VOR and use it as the overlay chart. For example, the correct position of the STJ VOR is to be plotted on the Kansas City chart. Place a straight edge on the intersection of north lat. 40° 05'00" and 94° 00'00" west long. Draw a *straight line* between these two points. The use of a razor blade for cutting along a straight edge is preferred. This chart will be mounted on the Des Moines chart by correctly aligning the central meridian of 95° 00'00" and placing the two points mentioned above in their correct position. The slight difference in the size of the two charts will fall away from the central meridian and allow the minimum error near the station. If it is necessary to join four charts together, it is suggested that the two north charts be mounted on the two south charts to form the east and west half, then the east and west sections may be mounted along a meridian such as 96° 00'00" ,making sure that the 40° parallel is in correct alignment and that the 96th meridian is in a straight line.

(3) The magnetic north reference may not be plotted from the facility location with magnetic variation interpolated from the lines of magnetic variation shown on the chart. The determination of the correct magnetic variation is extremely important. Whenever possible, the magnetic variation should be obtained from the latest information available through the Coast and Geodetic Survey. If the available information is not up to date, the annual rate of change in variation should be applied. It is conceivable that errors as great as 0.5° may occur if proper determination of magnetic variation is not made through use of the latest and most accurate source of this information.

(4) After the magnitude of magnetic variation has been determined, it is suggested that this be plotted on the chart using at least a 6-inch circular protractor and marking it from the true north reference, both north and south of the site and connecting the two points with a fine line which passes directly through the site. The 90° to 270° magnetic lines may be marked by resetting the protractor on the magnetic north reference.

306.4 Use of the Chart

a. In the selection of checkpoints, black should be used first, gray second, and blue (drainage) last. Only in rare cases will be the facility site be accurately located. Consequently, the facility location should always be plotted as outlined above.

b. One good checkpoint each 30° provides more repeatable results (provided constant radius is maintained) than large numbers of checkpoints using all types of map information.

c. If the same chart is used over an extended period of time, it may be necessary to realign the magnetic north reference line due to annual change in the variation. This is particularly true in some areas where the annual rate of change is extraordinary.